Solar Power System (SPS)
Operations & Maintenance Manual

Models SPS(G)12, SPS(G)24, SPS(G)36

with SC100 v.4 Controller

Doc. No. SPS36-Y01-001 Rev. C

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Northern Reliability

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Revision History

Revision	Date	Description of Change
x1	10/16/2012	Initial draft, unofficial document; system documents not included
Ax2	19NOV12	Consolidated for four sizes
B	07AUG14	Updated photos to PNL01 v.3, Updated HMI Screenshots, Updated Maintenance Section
C	19JAN14	Updated for SC100 v.4 with Raspberry Pi Data Gateway and Grid Interactive Circuits

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Northern Reliability warrants that all materials, equipment, and supplies furnished by the Company will be free of defects in design, materials, and workmanship for twelve (12) months after the date of installation by first end user or eighteen (18) months after the date of shipment, whichever comes first.

Northern Reliability's warranty obligation is limited to furnishing, on an exchange basis at the Company's cost, replacement for parts that have been promptly reported by the purchaser as defective and confirmed defective by Northern Reliability upon inspection. For service under this warranty, the purchaser must contact Northern Reliability to obtain a Return Authorization Number and shipping instructions. Defective parts must be returned to either Northern Reliability or an authorized Northern Reliability service representative. The returned part or product must include a brief description of the problem, including details of the mode of failure. This information is critical to a rapid disposition of the warranty claim.

This warranty is void in the event of purchaser, owner, or user neglect, improper installation (unless installation and commissioning is performed by Northern Reliability authorized personnel), natural disasters, or tampering or repairs by other than authorized Northern Reliability personnel.

The foregoing is in lieu of all other warranties, whether expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

The above limited warranty expressly excludes, and Northern Reliability shall not be liable for, any incidental or consequential damages caused by or related to the use of, inability to use, or malfunction of this product; nor for damages due to misuse or the use of any unauthorized attachment.

In addition, various components in the power system are covered by the appropriate vendor's warranty. The applicable vendor warranties are detailed in the attached vendor documentation and may or may not extend beyond the Northern Reliability system warranty.

This warranty can only be modified by Northern Reliability in a writing signed by an officer of the Company.

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1 About This Manual

Welcome to the SPS Operations, and Maintenance Manual. -This manual contains the information required for safe operation of the Solar Power System and drawings for the electrical and mechanical systems provided by Northern Reliability.

Any personnel tasked with installing, operating, monitoring, and maintaining this SPS power system should be familiar with the complete documentation package and should have it available for reference. Be sure to read the important safety instructions in Section 2 "Safety Information."

1.1 In This Manual

This manual is organized into the following sections:

- **Section 1 - About This Manual**
  Describes how this manual is organized.
- **Section 2 - Specifications**
- **Section 2.1 - Safety Information**
  Outlines how safety is handled throughout the manual and lists general safety precautions.
- **Section 3 - System Overview**
  Includes an overall description of the power system.
- **Section 4 - Component Descriptions**
  Describes each of the major components, including pictures of those components, and describes how the components interact with the overall system.
- **Section 5 - Data Gateway**
  Describes local HMI as well as web and/or Modbus SCADA system components and operation.
- **Section 6 -Commissioning and Operation**
  Includes regular start-up and shutdown procedures.
- **Section 7 -System Storage and Preservation**
  Describes procedures for storing and preserving batteries if system will be placed in storage.
- **Section 8 - Maintenance**
  Describes annual maintenance tasks that must be performed on the system.
- **Section 9 -Troubleshooting**
  Describes commonly found problems and their solution.

- **Appendix A — SPS Standard System Vendor Documentation**
  Includes vendor supplied documentation for the standard SPS components.

- **Appendix B — Customer Specific Documentation**
  Includes all customer specific system drawings and documents, any optional system component documents, and vendor supplied documentation specific to the customer's system and/or project.

1.2 Getting Help

If you have problems operating your power system, follow these steps:

1. See Section 9 -Troubleshooting for details. Many system details are covered in this section.

2. See relevant vendor documents included in Appendix A – SPS Standard System Vendor Documentation and Appendix B – Customer Specific Documentation for additional troubleshooting information by individual component.

3. Contact us at:

   Northern Reliability
   340 Mad River Park
   Waitsfield, VT 05673
   Tel: 802-496-2954
   Fax: 802-329-2096
   Email: info@northernreliability.com

If you have any comments, suggestions, or questions about this manual, please email us at info@northernreliability.com

SPS36 Product Line												
SPS36 Product Line	**12**				**24**				**36**			
Minimum Cabinet Size	APX 48w60h36d				APX 48w72h36d				APX 72w72h36d			
Autonomy (Days)	1	3	5	7	1	3	5	7	1	3	5	7
Average Continuous load (Watts)	525	163	94	63	1075	350	222	155	1600	540	350	245
Photovoltaic (PV) Array size (Watts)		1560	1560	1560		2340	2340	3120		3900	3120	3900
Generator Size/Type		2.5W PROP				6.5kW PROP				6.5kW PROP		
Battery Voltage	24				24				24			
Battery Type	100G13				100G13				100G13			
Number of Strings	1				2				3			
Battery Cap-acity (kWHrs)	11.52				23.04				34.56			
Gross System Weight (lbs)	1600	2500	2200	2200	3300	4600	4300	4600	4800	6300	6000	6300
Rectifier Size (kW)		1.6				4				4		
System Controller Ver.4	SC-100				SC-100				SC-100			
Nominal Annual Fuel Consumption		59 Gal				158 Gal				167 Gal		
Nominal Annual Genset Run Time		118 Hrs				272 Hrs				288 Hrs		

2.1 Safety Information

This section describes the safety symbols, definitions, and precautions used and discussed throughout this manual. Anyone operating, opening, or servicing this equipment should read Section 7 "Start-up and Operation" before attempting to start or operate the system. Refer also to the vender documentation included in Appendices A and B for specific warnings related to the individual system components.

Safety Symbols and Definitions

The following is a list of safety definitions and symbols noted throughout the manual and/or located on your power system.

Table 2-1 Safety Symbols and Definitions

DANGER	DANGER indicates an imminently hazardous situation, which, if not avoided will result in death or serious injury.
WARNING	WARNING indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.
CAUTION	CAUTION indicates a potentially hazardous situation, which, if not avoided, could result in minor or moderate injury.
NOTICE	NOTICE used for stating instructions or for the protection of personnel or property; indicates a potentially hazardous situation that, if not avoided, may result in damage to the equipment.
	This symbol indicates a potential electrical hazard.
	This symbol indicates that safety glasses are required.
	This symbol indicates a potential chemical hazard.
	This symbol indicates a potential burning hazard.

2.2 Safety Precautions

Proper precaution must be followed by anyone installing, opening, operating, or servicing the equipment. Become familiar with this entire manual as well as the vendor documentation included in Appendices A and B before opening the cabinet.

2.2.1 Equipment Electrical Hazards

When following safety precautions in this manual, the following equipment electrical hazards apply.

Table 2-2. Equipment Electrical Hazards

Equipment	Maximum Voltage
PV Array	174 Volts DC
Control System	28.5 Volts DC
Optional Generator/Customer AC Loads	120/240 Volts RMS AC
Optional Customer DC Loads (with optional 24VDC to 48VDC converter)	48 Volts DC

3 System Overview

This section provides an overview of the Solar Power System ("SPS") and its options. A detailed description of each component is included in Section 4 "Components Description".

3.1 System Introduction

The SPS36 line of solar power systems is engineered to power a 50 to 500 Watt average continuous load. The system utilizes photovoltaic modules as the primary source of power. The SPS(G) option incorporates a generator to provide back-up power during periods of poor solar conditions. This manual outlines the specific configurations of the system's photovoltaic array, generator, and battery bank sizes. High reliability, redundancy, low maintenance, and low operational costs have been designed into the SPS system. The system has protection from over-voltage, under-voltage, over-temperature, and surge conditions. In most cases, the system will resume normal operation automatically after an abnormal condition has cleared.

3.1.1 Power Generation

The power sources consist of a photovoltaic ("PV") array and, when equipped with the option, a propane or diesel generator customized for extended run time and cold weather operation.

3.1.2 Power Storage

Power is stored in a state-of-the-art sealed, deep cycle, absorbed glass mat ("AGM"), valve regulated lead acid ("VRLA") battery. The battery is explosion resistant, freeze tolerant, spill resistant, leak resistant, has a gas recombination efficiency exceeding 99%, and has no equalization charge or watering requirements. The storage battery integrates power sources, effectively reducing the fluctuations that can occur with renewable energy generation, and provides a stable source of DC power to critical loads.

3.1.3 System Enclosure

The SPS Power Equipment Shelter ("PES") is an insulated and ventilated metal enclosure that houses the battery bank, the SC100 control system, environmental and energy conversion equipment, and customer load equipment. When equipped with a generator, the generator is mounted outside the PES in a Generator Weather Shield.

3.1.4 System Controls

The Northern Reliability System Controller, SC100 version 4, is Programmable Logic Controller ("PLC") based, and contains control relays, electrical bussing, distribution, protection and energy conversion equipment. The SC100 communicates serially with the Maximum Power Point Tracking ("MPPT") solar charge controller and Data Gateway/HMI. The System Controller's functions include:

- Primary battery charging via the MPPT
- System fault, alarm, and status notifications

- Battery Low Voltage Disconnection ("LVD")
- Interior environmental monitoring and control
- Generator and battery charge control, when equipped with the generator option
- Monitoring and data logging via the Data Gateway/HMI

3.2 System Components

The SPS System Components consist of the following:

Table 3-1. SPS Standard Components and Equipment

Equipment/Component	Description
PV Array	Two or three strings of PV Modules
Battery Bank	24VDC string(s), 600-1800Ahr, VRLA, AGM
PV Charge Controller	MidNite Classic MPPT Charge Controller(s)
PLC	Allen-Bradley Micro 850 PLC
HMI/Data Gateway	Raspberry Pi with Web Interface
Heaters	Battery-mounted Heat Pads
Vent Gates	Fan, damper, and actuator Assemblies (2)

Your system(s) may include one or more of the following optional components:

Table 3-2. SPS Optional Components and Equipment

Equipment/Component	Description
Generator (for SPS(G) models)	Liquid Propane 2.5-6k.5W or Diesel 7.5kW
Rectifier (for SPS(G) models)	Cordex redundant CXC 24VDC modules
Inverter	Exeltech XP True sine wave 250W-2kW
Inverter	Outback FX Grid Interactive 2.5kW
Auxiliary Generator Connection	120VAC input with changeover switch
DC/DC Converter	24VDC to 12, 24 or 48VDC
Mobility Package	Integrated highway rated trailer

3.3 1-Line Electrical Schematic

The following is the SPS36 1-Line Electrical Schematic.

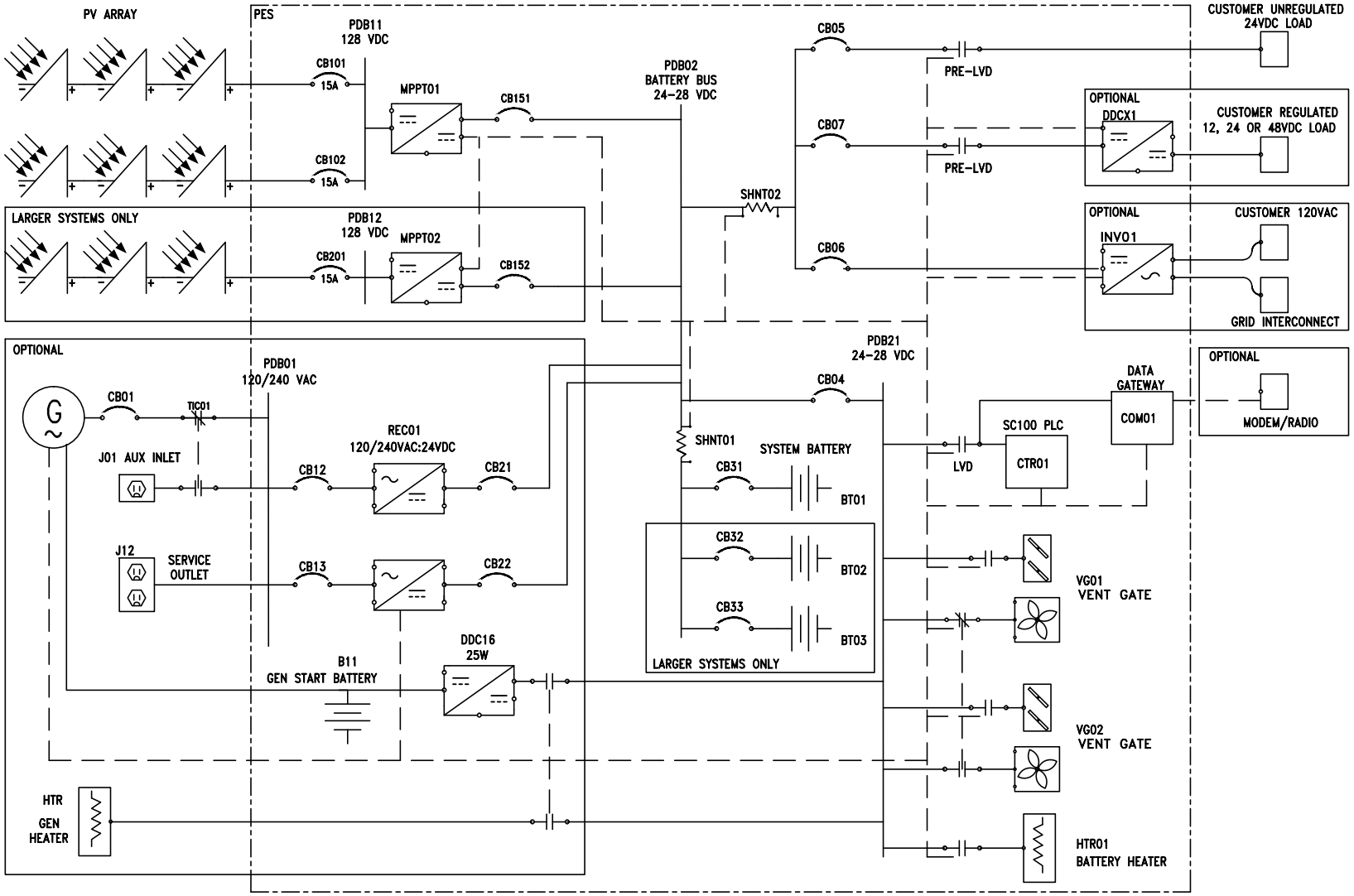


Figure 3-1. SPS36 1-Line Drawing (shown with generator option)

4 Component Descriptions

This section describes the following SPS standard and optional system components:

- Power Generation
- Power Storage
- Environmental System
- Load Management
- Generator / Rectifier (optional)

4.1 Power Generation—Photovoltaic Array

The PV array is the primary energy source for the system, providing the energy required to charge the battery bank and support customer, control, and environmental loads.

The PV array is composed of two or three strings of modules mounted on an aluminum structure. Alternatively the PV may be mounted on existing structures such as utility or communication towers. The PV array is configured as two or three strings of modules, with a nominal module voltage of about 30 volts DC each. The output of each string is protected by its own circuit breaker. The photovoltaic power is regulated by an MPPT charge controller, which constantly tracks the electrical operating conditions of the PV modules and optimizes power output for the available solar resource. This process ensures maximum utilization of the solar power, especially as environmental conditions change.

Figure 4-1. Typical SPS PV Array on Aluminum Structure

4.2 Power Storage

The battery bank is composed of GNB Absolyte GP battery modules. The batteries are state-of-the-art deep cycle, lead acid construction with the following characteristics:

- Sealed telecommunications grade
- AGM, VRLA technology
- Ampacity greater than 5 times peak charge rate
- Period of autonomy is defined as time it takes the battery discharge from 100% State of Charge ("SOC") to 80% Depth of Discharge ("DOD"), at the 100 hour discharge rate and nominal battery temperature of 77 °F. Actual autonomy is dependent on the specific battery size option chosen, and load size.

The batteries are freeze tolerant, spill and leak resistant, maintenance free, and have no equalization charge or watering requirements when operated according to manufacturer's specifications.

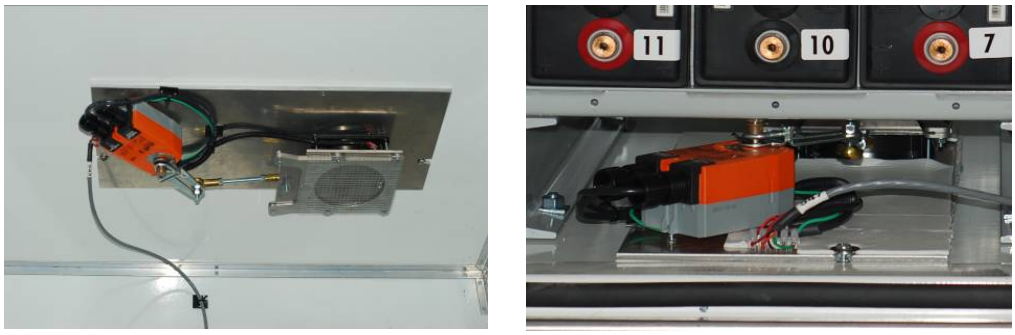
The battery voltage varies under normal operation. Under charging conditions, the battery voltage can rise to approximately 28.5 VDC for the 24-volt system. Under discharge conditions the voltage can vary down to approximately 23.5 VDC for the 24-volt system, depending on the battery bank state of charge.

Figure 4-2. Typical SPS Battery Banks (configuration varies by option)

4.3 Environmental System

4.3.1 Cooling

The environmental system cools the enclosure by ventilation via fan, filters, and active dampers. The environmental system operations are directed by the System Controller. When the enclosure temperature exceeds the set point and the outside air is cool enough to warrant the air transfer two vent gates open and a fan comes on to ventilate the system.



Roof vent gate

Floor vent gate

Figure 4-3. Vent Gate Assemblies

Cooling is by air exchange only. The interior air temperature can be maintained within 20F of outside air temperature. There are no active cooling, air conditioner type, devices.

4.3.2 Heating

The enclosure is heated by waste heat from the electrical components inside of it. When the air temperature inside the enclosure is insufficient to maintain the battery temperature the system will command on battery heaters. These resistive pad heaters are adhered to the bottom of the battery modules and are covered with flexible insulation.

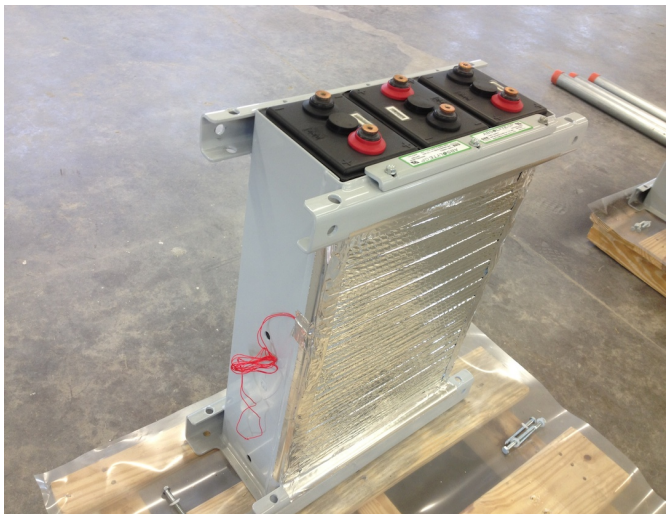


Figure 4-4 Battery Heater Pad

4.4 System Controller

The SPS System Controller, SC100 version 4, is responsible for the supervisory control of the overall power system. It directs power to the loads and provides load management and system alarms to ensure the battery and connected loads remain within acceptable limits.

The main component of the System Controller is an Allen-Bradley Micro 850 PLC, which manages environmental conditions, system loads, and system alarming, as well as generator-based battery charging through its embedded charge algorithms when equipped with the generator option.

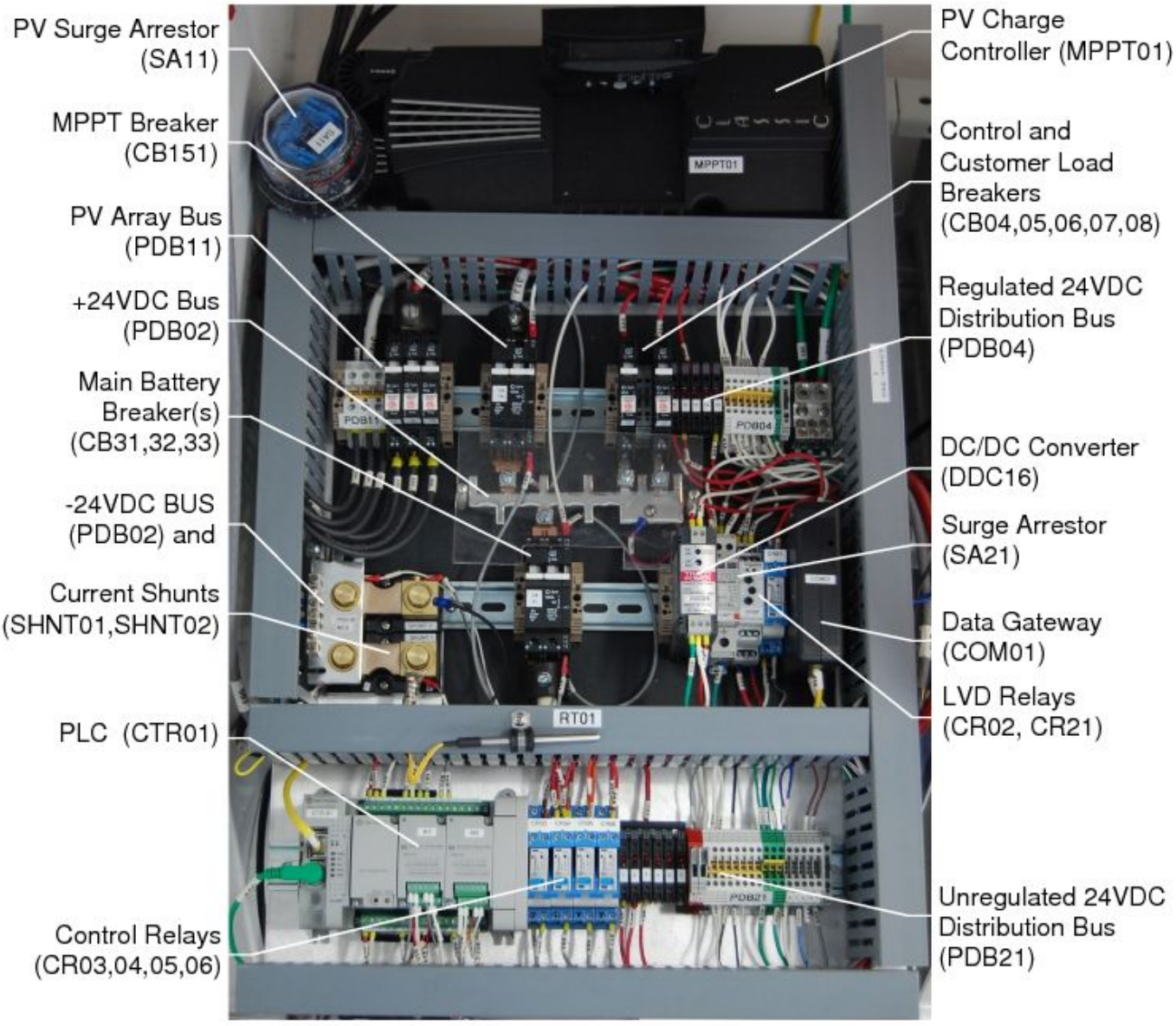


Figure 4-5. SC100 version 4 Control Panel

The PLC provides load management protection of the battery based on voltage. This feature ensures that the loads operate within their proper voltage range. Load management control protects the battery from being excessively discharged should the charge sources fail to support the load. All system control set points are factory adjusted to ensure compatibility with the selected batteries and PV array configuration, as well as the connected customer load.

Active components are included in the system design to support and protect the system operation. The following sections describe in detail the operation of these additional items.

4.4.1 Photovoltaic Charge Controller

The PV array is wired into a MidNite Classic MPPT charge controller, located at the rear of the control panel. The charge controller is configured for a 24VDC battery.

Figure 4-6. MPPT Controller

Reference the MidNite Solar vendor documentation provided in Appendix A of this manual for additional details.

4.5 Generator / Rectifier (optional)

The SPS(G) series of SPS systems are equipped with a back-up propane generator to provide power during periods of low solar output. When sunlight conditions do not allow the PV array to adequately power the load and maintain the battery's minimum state of charge, the SC100 will start the generator in order to provide the necessary charge current to the batteries.

Smaller systems are typically equipped with an Onan 2.5kW Propane generator and larger systems with an Onan 6.5kW propane generator. A 7.5kW diesel generator can be provided as well.

4.5.1 SPS(G)12 Small System configuration

Figure 4-7. 2.5kW Propane Generator in Weather Shield

Figure 4-8. 1.6kW 120VAC Rectifier and Generator Controls

4.5.2 SPSG24 and SPSG36 Large System configuration

Figure 4-9 6.5kW Propane Generator in Weather Shield

Figure 4-10 4kW 240VAC Rectifier and PNL02 Generator Controls

The generator supplies power to the rectifier, which in turn charges the batteries. The rectifier employs a staged, "soft start" technology to ensure the generator is running properly before it begins charging the batteries. The SC100 provides for a cool down period by switching off the rectifier and running unloaded prior to shutting down the generator at the end of a charge cycle.

4.6 Load Management

The battery voltage ranges from 23.5 volts to 28.5 volts DC.

4.6.1 24 Volt DC Distribution

24 volts DC distribution is achieved through din rail mounted circuit breakers and fuses, located on the controller panel within the system enclosure. The following table lists the circuit breaker allocations and their functions:

Table 4-1. Circuit Breaker Table

Circuit Breaker	Size and Type	Circuit Breaker Function
CB101	15AMP DC	PV String 1 Input
CB102	15AMP DC	PV String 2 Input
CB103	15AMP DC	PV String 3 Input
CB151	100AMP DC	MPPT1 Output
CB152	100AMP DC	MPPT2 Output
CB04	20AMP DC	Control Loads
CB05	10AMP DC	Customer Loads
CB31, CB32, CB33	100AMP DC	Battery Strings
CB12, CB13	20AMP AC	Rectifier AC Inputs (included only in SPS(G) series systems)
CB21, CB22	65AMP DC or 250AMP DC	Rectifier DC Output (included only in SPS(G) series systems)

4.6.2 Optional Alternate Voltages for Customer Loads

Options are available to provided customer loads with Various DC voltages up to 48 volts DC (positive or negative ground), and/or 120 volts AC power via DC-DC or DC-AC converters.

Table 4-2. Options Circuit Breaker Table

Circuit Breaker	Size and Type	Circuit Breaker Function
CB06	size dependent	Optional DC-AC Inverter Input
CB07	size dependent	Optional DC-DC Converter Input

4.6.3 Grid Interactive Systems

Systems that are Grid Interactive utilize an Outback Power FX type inverter/charger, INV01. This component is used to support the load and float charge the battery when PV power is insufficient. When there is excess PV energy the device places it back onto the local AC bus. AC distribution and protection for this option are located on panel 3, PNL03, as well other customer distribution options such as 12, 24 or 48VDC feeds. A utility outlet, J12, is provided with the grid interactive option.

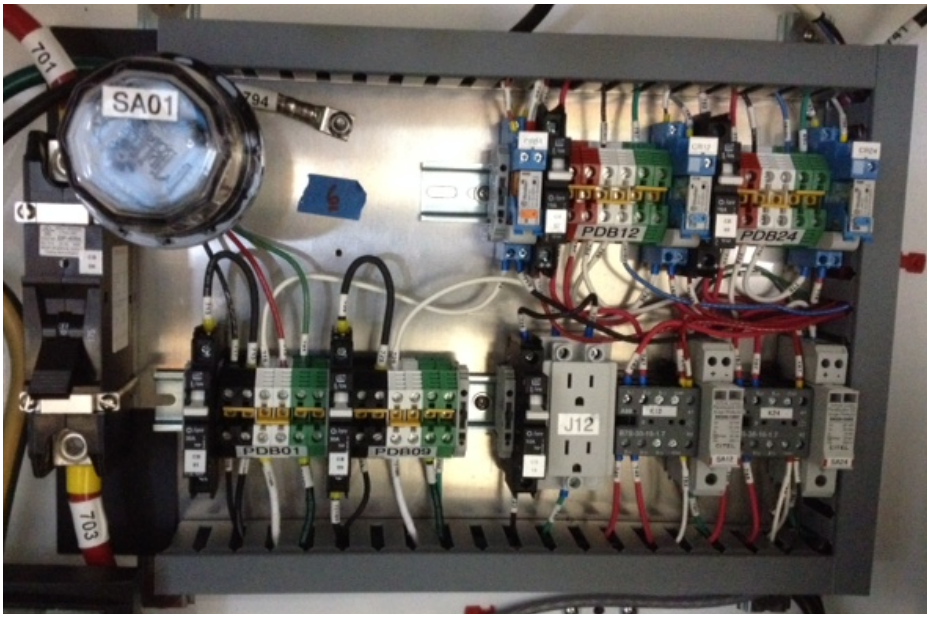


Figure 4-11 PNL03 AC Protection and Customer Distribution

Figure 4-12 Grid Interactive Inverter/Charger

5.1 Data Gateway, Web Interface

The following figures illustrate the information and functionality available on the Data Gateway web based user interface

5.1.1 Logging On

- Move close to a Northern Reliability SPS power system
- Use a wifi enabled laptop, tablet or smart phone and log on to the wifi network with an SSID of "RPiAccessPointXXX" where XXX represents letters specific to the project. Use password 34044100.
- Use a web browser and navigate to 10.19.3.27
- Select between the HOME screen and the ALARM screen

5.1.2 Home Screen

The HOME screen displays basic system data.

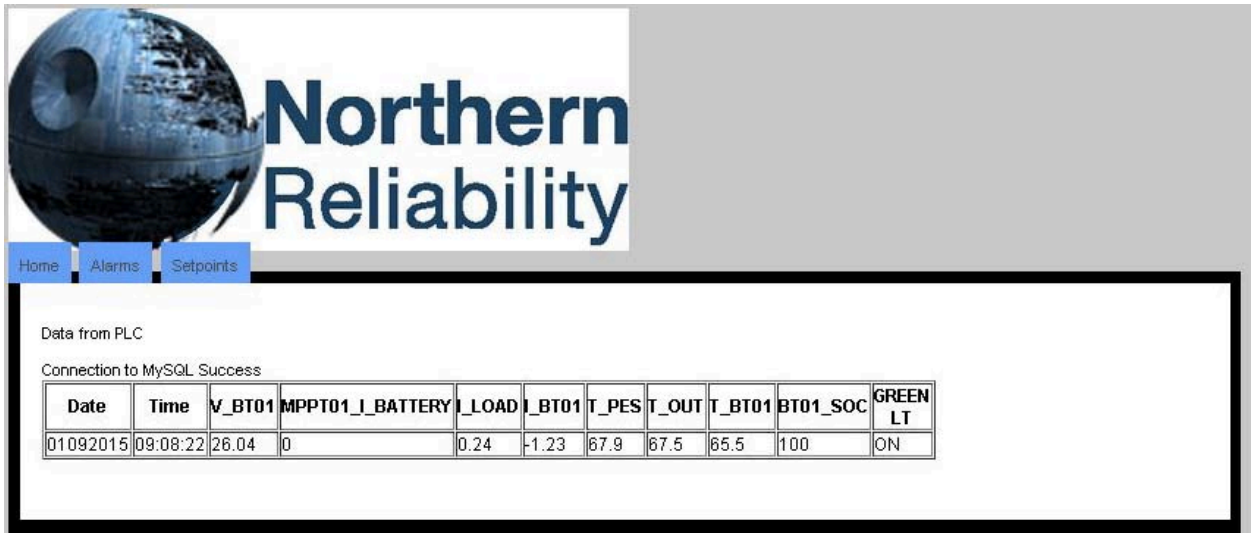


Figure 5-1 Web Interface HOME screen

Web Interface Label	Description	Eng. Units
V_BT01	Main Battery Voltage	Volts DC
T_BT01	Main Battery Temperature	Degrees F
T_PES	Cabinet Air Temperature	Degrees F
T_OUT	Outside Air Temperature	Degrees F
I_LOAD	Total Load Current, Customer and House Loads	Amps DC
I_BT01	Battery Current, negative value indicates discharge	Amps DC
MPPT01_I_BATTERY	MPPT Output Current	Amps DC
BT01_SOC	Battery State of Charge	%
GREEN LT	ON= System Healthy OFF= Common Alarm	

Figure 5-2 HOME Screen Key

5.1.3 Alarms Screen

The Alarms screen shows standing alarms and other status points

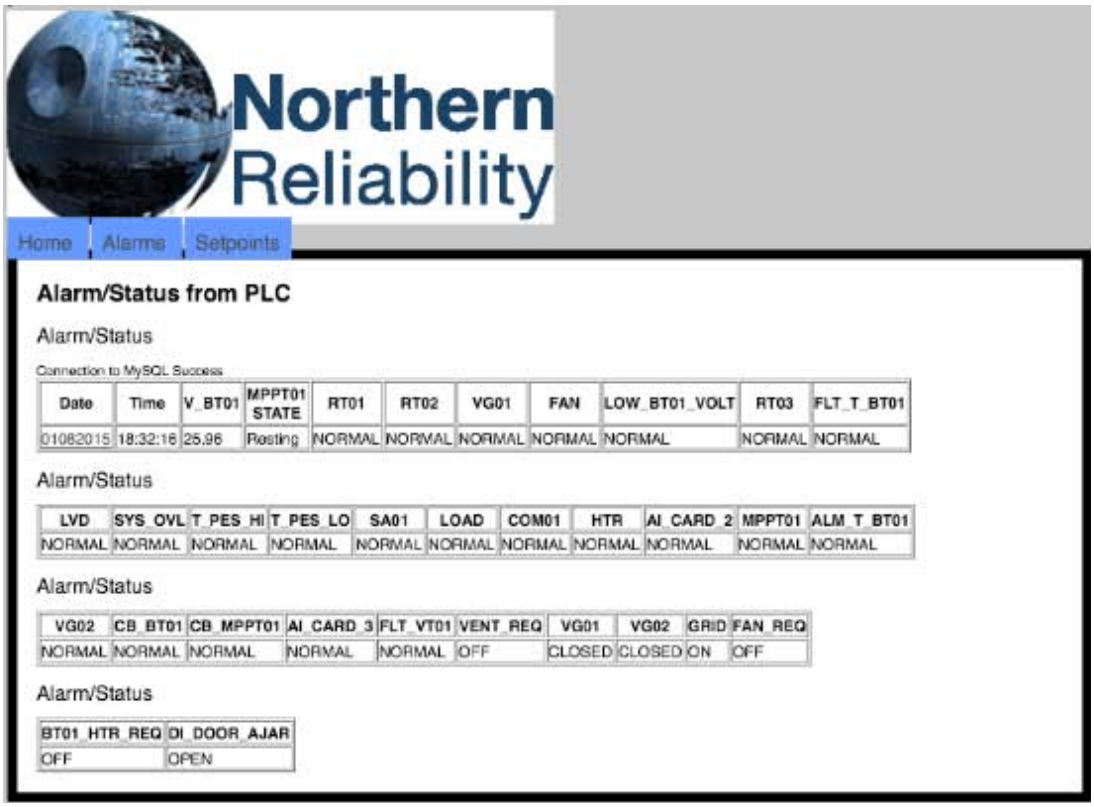


Figure 5-3 Web Interface ALARMS screen

Web Interface Label	Description	Eng. Units
V_BT01	Main Battery Voltage	Volts DC
AI_CARD_2	Analog Card in slot 2 is reporting a fault	
AI_CARD_3	Analog Card in slot 3 is reporting a fault	
BT01_HTR_REQ	A battery heater request is active	
COM01	Communications between MPPT and PLC lost	
DI_DOOR_AJAR	Door Ajar	
FLT_T_BT01	Both Battery Temperature Measurements Bad- Inibits Battery Heater	
FLT_T_BT01	Battery temperarure outside of set point limits	
FLT_VT01	Voltage Divider Fault - voltage from divider not within limits	
GRID	Grid AC Power is available	
LOAD	Load Fault - One or more customer load bus not energized	
LOW_BT01_VOLT	Battery Voltage below set point limit	
LVD	Low Voltage Disconnect of Customer Loads, 5 minute delay	
MPPT01	MPPT is reporting an internal fault	
MPPT01 STATE	The Charging Mode of the MPPT	
RT01	Cabinet Temperature Sensor Fault	
RT02	Outdoor Temperature Sensor Fault	
RT03	Battery Temperature Sensor Fault	
SA01	One or more Surge Arrestors have tripped	
SYS_OVL	System Overload Fault Load > Setpoint for 6 hours	
T_PES_HI	Cabinet Temperature above set point limit	
T_PES_LO	Cabinet Temperature below set point limit	
VENT_REQ	A cabinet ventilation request is active	
VG01	The roof vent gate is stuck open or closed	
VG01	Roof vent position Open or Closed	
VG02	The floor vent gate is stuck open or closed	
VG02	Floor vent position Open or Closed	

Figure 5-4 ALARMS screen key

5.1.4 Set points Screen

This page is under Construction and may not be available:

The Set points screen shows system control set point values. Some can be edited from here as well, for modification of system functions. Consult with Northern Reliability technical support prior to changing any of these values.

5.2 Data Logging

The Data Gateway logs data and stores data in a SQL database locally on a micro SD card. It also creates and transfers .csv files to a specified cloud server for processing. With internet connected devices the logged data can be retrieved remotely. Accessing the logged data from non-internet connected dataloggers will require removing the memory card and sending it to Northern Reliability.

5.2.1 Retrieving Files Locally

To retrieve locally swap the datalogger SD Card:

- Request a formatted, preprogrammed micro SD card from Northern Reliability.
- Power off the Data Gateway by opening fuse F12.
- Remove the micro SD card from the Data Gateway by gently pressing on the card located in a slot on the rear of the box. It may be necessary to remove the black plastic Data Gateway box from the DIN rail. Take care in handling as the memory card is extremely small.

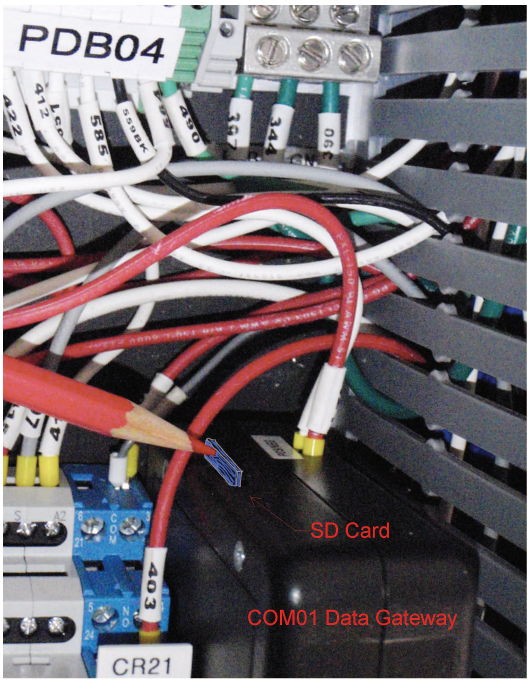


Figure 5-5 Data Gateway

- Insert the new, preprogrammed micro SD card and reinstall the Data Gateway onto the DIN rail.
- Power on the Data Gateway by closing fuse F12.
- Mail the card to:

  Northern Reliability
  Attn: Tony Uzabel
  340 Mad River Park
  Waitsfield, VT 05673

- Include SPS system serial number and physical location, along with any observations.

5.2.2 Retrieving Files Remotely

On SPS systems that are connected to the internet comprehensive data files can be can be retrieved by Northern Reliability Engineers remotely for troubleshooting purposes.

5.2.3 Automatic Uploads to .ftp site

SPS systems that are connected to the internet will automatically upload .csv files of base performance data to the Northern Reliability Server in Waitsfield VT daily.

5.2.4 Alarm Email

SPS systems that are connected to the internet will also send alarm emails to configured email groups. Attached to the alarm email is a .csv file containing a snapshot of the system conditions prior to, and at the time of the alarm

6 Commissioning and Operation

This section is provided as a general guideline for applying power to a system that has been shut down. It applies both to systems being powered up for the first time (commissioning), or to powering systems that have been shut down for maintenance, service, or storage.

Following the procedures in this Section assumes the system and any associated equipment has not been damaged or altered in any way. If after inspecting the system you determine there is damage to any component, please promptly contact Northern Reliability for instructions before powering up the system.

Note: If at any time during this procedure you encounter problems, refer to Section 9 "Troubleshooting" or the troubleshooting sections of the relevant system component vendor documentation included in Appendix A and Appendix B.

6.1 Safety Information for Start-up and Operation

The following safety warning information should be noted:

Table 6-1. Safety Information During Start-up and Operation

Safety Warning	Description
	Photovoltaic (PV) solar modules produce current when exposed to light. Exercise care when handling PV modules during transport, installation, and disassembly. Do not enter junction panel boxes and attempt connections if a PV module is exposed to light. Shade PV modules if any electrical work must be performed
	Personnel may be exposed to up to 135 Volts DC during system operation. Do not operate system without guards in place.
	Batteries contain sulfuric acid and can emit explosive gases. Always wear safety glasses or goggles when handling batteries.
	Avoid accidentally touching battery terminals with tools or any metal objects.

6.2 Pre-Check

Before starting the system, see Installation Instructions (document W04) included in Appendix B to confirm the system is properly installed. Once confirmed, proceed with the following:

1. Verify all system wiring is intact and in good physical condition.
2. Verify all system circuit breakers are off (use system one-line schematic for reference, Figure 3-1 above).
3. Verify system earth ground is in place and is securely connected.
4. Verify the photovoltaic array is properly installed and wired.

6.3 Power Up

After each circuit breaker closure, inspect applicable equipment.

NOTICE

Never force a circuit breaker on after it has tripped. If a circuit breaker trips during closure, inspect the wiring for that circuit and replace faulty wire and/or equipment as necessary.

To power up the system:

1. Turn on main battery disconnect (CB31).
2. Turn on the control bus breaker (CB04)
3. Turn on MPPT disconnect breaker (CB151).
4. Turn on PV array disconnect (CB102, CB102, and/or CB103). The PV array should now be operational.
5. Turn on customer load breakers (CB05, CB06 and/or CB07).

After completing the above steps, the system is operational. Perform the following checks to verify sub-system operation:

1. Verify system battery voltage is within system operational tolerance. The battery voltage should be in the range of 24 Volts DC to 28.5 Volts DC.
2. The system is now energized.
3. Ensure all faults are clear and confirm the battery voltage displayed on the PLC LCD screen is accurate. Use the up, down and enter buttons to calibrate as necessary.

NOTICE

When powering up the system for the first time, a red indicator light may be on, indicating a low battery temperature failure. After installation and initial heating of the batteries, the LED indicator can be reset by opening and closing Fuse 1. Refer to section 7 System Storage and Preservation for cold system startup recommendations.

6.4 Secure the System

Remove all unnecessary materials from inside the enclosure, then close and latch the door. The SPS may be locked with a padlock for additional security.

6.5 PLC Operating Status Lights and Faults

Once operating, the lights located on the front of the control panel will alert the operator to the functioning of the system. When the Green Light is displayed, the system is functioning properly. When the Red Light is displayed, look at the datalogger webpage for details on the particular system fault. Refer to Figure 5-3 Web Interface ALARMS screen.

NOTICE	**After addressing the root cause, faults can be reset by opening and closing Fuse 11 on the control panel in order to cycle PLC power.**

7 System Storage and Preservation

The system can be stored indefinitely in a dry climate controlled environment. Battery degradation will occur over time and particularly under high temperature conditions. The MPPT has a replaceable internal battery with a finite life span. The main system battery requires recharging at intervals specified in the battery manual. For additional information, refer to the GNB Absolyte GP Battery Installation and Operating Instructions included in Appendix A.

The system is intended to operate with the main battery temperature within a range of 60-80 degrees F. If the system is commissioned with a cold battery the battery heater load will significantly impact the system autonomy. During a period of low insolation (December for example) there may not be enough PV energy to support both the customer load and heating load, and the customer load may be intermittently dropped until the battery temperature rises to the nominal level. To ensure reliable uptime immediately following commissioning, the battery should be kept warm, or should be preheated prior to commissioning.

8 Maintenance

This Section outlines the steps that should be taken on an annual basis for trouble free system operation or during system commissioning. Following these steps can greatly reduce system failures and maintenance costs.

Personnel responsible for system maintenance should always review the system manuals prior to deploying to the site. They should ensure that all maintenance parts and required tools are available for any on-site visits.

If access to the site is limited to a particular period of the year, schedule system maintenance for the early part of the season in case potential problems are noted that cannot be dealt with until a return visit.

8.1 Safety Information for Maintenance

The following safety information applies to system maintenance and servicing:

Table 8-1. Safety Information During Maintenance

Safety Warning	Description
	Personnel conducting maintenance activities may be exposed to up to 135 Volts DC. If possible, do not operate without guards in place and practice lock-out tag-out procedures when performing maintenance.

8.2 Annual Preventive Maintenance

Conduct an annual check of system parameters and component operation as outlined in this chapter. Follow the steps below for every annual maintenance visits:

8.2.1 Enclosure Inspection

The system enclosure is temperature controlled; therefore unintended penetrations can have detrimental effects on battery life and system efficiency. The following tasks should be completed annually to verify the enclosure envelope:

- ❑ Inspect enclosure door for proper operation and sealing.
- ❑ Inspect enclosure for insect or rodent infestation. Remedy if found.
- ❑ Check for water penetration inside of enclosure. Remedy if found.

8.2.2 Environmental Inspection

Perform the following tasks annual to validate the proper operation of the environment systems:

- ❑ Verify vent dampers in openings of the enclosure are clear of obstructions and debris.
- ❑ Inspect air filters for cleanliness. Clean or replace as necessary.
- ❑ Cycle upper and lower vent gate assemblies to demonstrate proper operations by manually operating relays CR04, CR05 and CR06.
- ❑ Cycle electric battery heater to demonstrate proper operations by manually operating relay CR03.

8.2.3 Power Equipment Inspection

The following tasks should be conducted on an annual basis, or more frequently as circumstances require.

- ❑ Visually examine that the controller and wiring are free of damage.
- ❑ Ensure all components and wiring is secured (*i.e.* torque each termination, being careful not to strip hardware).
- ❑ Inspect all circuit breakers with a digital voltage meter (DVM) for voltage drop across their terminals and for continuity. Replace any with a voltage drop greater than 0.1V.
- ❑ Visually examine lightning arrestors (SA11 and SA21) for signs of stress (*e.g.* burned or blackened). In proper working order, a blue light should be visible. Replace if visibly damaged, or if light is not operational.

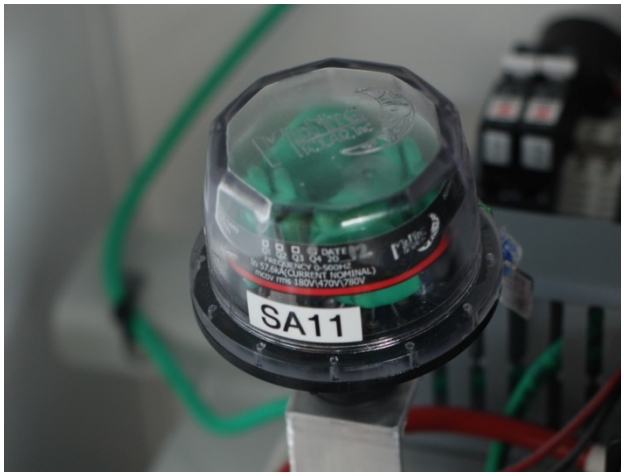


Figure 8-1. Lightning Arrestor

8.2.4 Testing Photovoltaic Array

The PV arrays are made up of series connected strings of PV modules. If PV output appears to not be operating properly, the PV strings should be tested to isolate any issues. **Open the PV disconnect(s), CB101, CB102, and/or CB103 inside the enclosure before checking the string outputs.** To verify the output of each PV string, measure the string outputs at the PV circuit breakers (CBs 101/102/103). To measure the strings' outputs, use a digital multi-meter. Open each circuit breaker and measure the open circuit voltage and short circuit current of each string. Also be sure to check the wiring of each circuit breaker as the strings are checked.

Record each string's output for future reference. Note that partial shading of any particular string, from trees or any other obstructions, will reduce its output. Cloudy weather conditions will also reduce the amount of direct sunlight available to the PV modules and therefore will reduce their power output.

For accurate results, try to test the strings only when clear weather conditions are present. Any individual module wiring or output problems are typically readily apparent in their impact on string measurements. Promptly identify and investigate any apparent problems or anomalies.

PV modules should be inspected annually to promote peak performance:

- ❑ Inspect modules for damage from inclement weather.
- ❑ Verify PV cables are free of damage and corrosion.
- ❑ Verify all structures are secure from wind and weather. Torque any necessary
- ❑ Visually examine PV array wiring for chafing, loose terminations, and proper routing.
- ❑ Visually examine PV array for solar collecting surface cleanliness.

8.2.5 Maintaining the Battery Bank

The system battery is maintenance-free, however the following routine checks should be made to help identify faulty cells and to satisfy manufacturer warrantee requirements:

- ❑ Inspect each cell closely for leaking acid or acid residue.
- ❑ Inspect battery terminals for corrosion and clean as necessary.
- ❑ Torque battery terminals to factory specifications.
- ❑ Measure and record each cell voltage individually. A cell with a voltage 10% or more below the average of all cells may be defective.
- ❑ Measure and record string temperature, making note of any temperature gradients.

For additional information on maintaining the battery bank, refer to the GNB Absolyte GP Battery Installation and Operating Instructions included in Appendix A.

8.2.6 Maintaining the Generator

Systems equipped with generators require the following additional generator maintenance done semi-annually:

- ❑ Check oil level, top off as necessary.
- ❑ Clean air filter housing of obstructions and debris
- ❑ Clean engine cooling fins.
- ❑ Clean spark arrestor.
- ❑ Inspect fuel supply hose, tube, and pipe fittings for leaks.
- ❑ Inspect exhaust systems for leaks.
- ❑ Inspect generator related wiring and mechanical components for damage, correcting as needed

Additional maintenance is required annually or as specified by the cumulative run-hours of the generator:

- ❑ Change oil and oil filter annually or every 150 run-hours.
- ❑ Replace air filter annually or every 150 run-hours.
- ❑ Replace spark plug and fuel filter every 450 run-hours

For additional information on maintaining the generator, refer to the Onan Installation and Operating Instructions included in Appendix A.

This Section describes Troubleshooting for the SPS.

9.1 Safety Information for Troubleshooting

When troubleshooting the SPS, follow the safety practices defined in this section:

Table 9-1. Safety Information During Troubleshooting

Safety Warning	Description
	Personnel conducting maintenance activities may be exposed to up to 174VDC. If possible, do not operate without guards in place and practice lock-out/ tag-out procedures when performing maintenance.
	Wear safety glasses or goggles whenever starting up or working on the system.
	Exercise caution when servicing and working on the system. There is potential for an electrical hazard.

9.2 Tools Required for Troubleshooting

The following tools should be on hand for troubleshooting:

- Digital Multi-Meter (DMM)
- Various hand tools
- Inspection Mirror

9.3 PV Array Problems

Indications	Recommended Action
No PV array current at controller	❑ Check for shading obstructions and clean panels. ❑ Inspect array wiring and check PV string circuit breakers. ❑ Inspect combiner cables. ❑ Check for vandalism; check controller input/output CBs.
Long period of extremely poor solar conditions	❑ Charge batteries with a sealed AGM compatible portable battery charger. **WARNING: Using the wrong type of battery charger will damage the batteries**.

9.4 Low Battery State of Charge

Indications	Recommended Action
PV Charge controllers not charging	❑ Check for PV array current at controller. ❑ Check for correct charge control settings. *(See MidNite Solar vendor documentation included in Appendix A – Standard System Documentation for details.)*
Measure battery module voltages	❑ Replace battery cells if necessary. *(See GNB Absolyte vendor documentation included in Appendix A Standard System Documentation for additional testing information.)*

9.5 Additional Support

If you cannot identify or correct a system problem, please contact us at:

Northern Reliability, Inc.
340 Mad River Park
Waitsfield, VT 05673
Phone: (802) 496-2954
Fax: (802) 329-2096
Email: info@northernreliability.com
Website: www.northernreliability.com

10 Glossary

10.1 Glossary

Acronym	Full Term
AGM	Absorbed Glass Mat
LVD	Low Voltage Disconnect
MPPT	Maximum Power Point Tracking
PES	Power Equipment Shelter
PLC	Programmable Logic Controller
PV	Photovoltaic
SCADA	Supervisory Control and Data Acquisition
SOC	State of Charge
SPS	Solar Power System
VRLA	Valve Regulated Lead Acid

Appendix A — Standard System Documentation

The following component documentation is included in this manual:

Description
Vendor Documentation for Batteries
Vendor Documentation for MTTP Charge Controller
Vendor Documentation Data Gateway
Vendor Documentation for PV Modules

Appendix B — Customer Specific Documentation

The following list identifies Customer and Project specific documentation that may be associated with your project:

Document No.	Description
B01-001	Key Design Sketch
B02-001	System Overall Assembly
J01-001	Electrical Single Line Schematic
J06-001	Electrical Two-Line Schematic
K02-001	System Detailed Assembly
K02-002	Battery /Control Enclosure
K02-003	PV Battery Array Assembly
K02-004	System Wiring Assembly
W04-001	Installation Instructions
Vendor Documents	Generator Manuals
Vendor Document	Rectifier Manual
Vendor Document(s)	Energy Conversion Manual(s)
Vendor Document	Obstruction Lighting Owner's Manual
Vendor Document	Other

ABSOLYTE® GP

SECTION 92.61 2010-02

Installation and Operating Instructions For ABSOLYTE® GP Batteries

UL Recognized Component

EXIDE TECHNOLOGIES
INDUSTRIAL ENERGY

INDEX

LIST OF ILLUSTRATIONS

APPENDICES

SECTION 1

1.0 General Information

The Absolyte GP battery is of the valve-regulated lead-acid (VRLA) design and so can operate with lower maintenance (e.g. no maintenance water additions) in comparison to conventional flooded lead-acid batteries. The Absolyte GP VRLA design is also inherently safer than conventional flooded lead-acid batteries. Under normal operating conditions and use, the Absolyte GP battery minimizes hydrogen gas release, and virtually eliminates acid misting and acid leakage. However, there is the possibility that under abnormal operating conditions (e.g. over-charge), or as a result of damage, misuse and/or abuse, potentially hazardous conditions (hydrogen gassing, acid misting and leakage) may occur. Thus, EXIDE recommends that Section 2.0 of these instructions entitled "SAFETY PRECAUTIONS" be reviewed thoroughly prior to commissioning, and strictly followed when working with Absolyte GP batteries.

CAUTION!

Before proceeding with the unpacking, handling, installation and operation of this VRLA storage battery, the following general information should be reviewed together with the recommended safety precautions.

SECTION 2

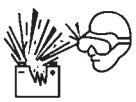
2.0 Safety Precautions

2.1 Sulfuric Acid Electrolyte Burns

DANGER SULFURIC ACID ELECTROLYTE BURNS

"Warning: Risk of fire, explosion or burns. Do not disassemble, heat above 50°C or incinerate." Batteries contain dilute (1.310 nominal specific gravity) sulfuric acid electrolyte which can cause burns and other serious injury. In the event of contact with electrolyte, flush immediately and thoroughly with water. Secure medical attention immediately.

When working with batteries, wear rubber apron and rubber gloves. Wear safety goggles or other eye protection. These will help prevent injury if contact is made with the acid.



DANGER EXPLOSIVE GASES

2.2 Explosive Gases

Hydrogen gas formation is an inherent feature of all lead acid batteries. Absolyte GP VRLA batteries, however, significantly reduce hydrogen formation. Tests have shown that 99% or more of generated gases are recombined within the cell under normal operating conditions. Under abnormal operating conditions (e.g. charger malfunction), the safety valve may open and release these gases through the vent. The gases can explode and cause blindness and other serious injury.

Keep sparks, flames, and smoking materials away from the battery area and the explosive gases.

All installation tools should be adequately insulated to minimize the possibility of shorting across connections.

DANGER ELECTRICAL SHOCK AND BURNS

Never lay tools or other metallic objects on modules as shorting, explosions and personal injury may result.

2.3 Electrical Shock and Burns

Multi-cell systems attain high voltages, therefore, extreme caution must be exercised during installation of a battery system to prevent serious electrical burns or shock.

Interrupt the AC and DC circuits before working on batteries or charging equipment.

Assure that personnel understand the risk of working with batteries, and are prepared and equipped to take the necessary safety precautions. These installation and operating instructions should be understood and followed. Assure that you have the necessary equipment for the work, including insulated tools, rubber gloves, rubber aprons, safety goggles and face protection.

CAUTION!

If the foregoing precautions are not fully understood, clarification should be obtained from your nearest EXIDE representative. Local conditions may introduce situations not covered by EXIDE Safety Precautions. If so, contact the nearest EXIDE representative for guidance with your particular safety problem; also refer to applicable federal, state and local regulations as well as industry standards.

2.3.1 Static Discharge Precautions for Batteries

When maintaining the batteries, care must be taken to prevent build-up of static charge. This danger is particularly significant when the worker is electrically isolated, i.e. working on a rubber mat or an epoxy painted floor or wearing rubber shoes.

Prior to making contact with the cell, discharge static electricity by touching a grounded surface.

Wearing a ground strap while working on a connected battery string is **not** recommended.

2.4 Safety Alert

The safety alert symbol on the left appears throughout this manual. Where the symbol appears, obey the safety message to avoid personal injury.

2.5 Important Message

The symbol on the left indicates an important message. If not followed, damage to and/or impaired performance of the battery may result.

SECTION 3

3.0 Receipt of Shipment

Immediately upon delivery, examine for possible damage caused in transit. Damaged packing material or staining from leaking electrolyte could indicate rough handling. Make a descriptive notation on the delivery receipt before signing. Look for evidence of top loading or dents in the steel modules. If cell or unit damage is found, request an inspection by the carrier and file a damage claim.

3.1 Concealed Damage

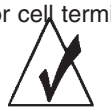
Within 10 days of receipt, examine all cells for concealed damage. If damage is noted, immediately request an inspection by the carrier and file a concealed damage claim. Pay particular attention to packing material exhibiting damage or electrolyte staining. Delay in notifying carrier may result in loss of right to reimbursement for damages.

SECTION 4

4.0 Storage Prior to Installation

4.1 Storage Location

If the battery is not to be installed at the time of receipt, it is recommended that it be stored indoors in a cool [77°F (25°C) or less], clean, dry location. Do **not** stack pallets or cell terminal damage may occur.



4.2 Storage Interval

The storage interval from the date of battery shipment to the date of installation and initial charge should not exceed six (6) months. If extended storage is necessary, the battery should be charged at regular intervals until installation can be completed and float charging can be initiated. When in extended storage, it is advised to mark the battery pallets with the date of shipment and the date of every charge. If the battery is stored at 77°F (25°C) or below, the battery should be given a freshening charge (perform per Section 11 Initial Charge) within 6 months of the date of shipment and receive a freshening charge (perform per Section 11 Initial Charge) at 6 month intervals thereafter. Storage at elevated temperatures will result in accelerated rates of self discharge. For every 18°F (10°C) temperature increase above 77°F (25°C), the time interval for the initial freshening charge and subsequent freshening charges should be halved. Thus, if a battery is stored at 95°F (35°C), the maximum storage interval between charges would be 3 months (reference Appendix B). Storage beyond these periods without proper charge can result in excessive sulphation of plates and positive grid corrosion which is detrimental to battery performance and life. Failure to charge accordingly may void the battery's warranty. Initial and freshening charge data should be saved and included with the battery historical records; (see Section 15 - Records).

SECTION 5

5.0 Installation Considerations

Prior to starting installation of the Absolyte Battery System, a review of this section is strongly recommended.

Any modifications, alterations or additions to an Absolyte system, without the expressed written consent of EXIDE Engineering, may void any warranties and/or seismic qualifications. Contact your EXIDE representative for additional information.

5.1 Space Considerations

It is important to know certain restrictions for the area where the battery is to be located. First, a designated aisle space should be provided to permit initial installation as well as for service or surveillance. After installation, any additional equipment installed after the battery should not compromise access to the battery system.

A minimum aisle space of 36 inches from modules / 33 inches from covers should be available adjacent to the battery system. See Figure 1 for typical space allocations required. Following the spacing requirements will aid in maintenance of the battery and help maintain air flow to battery surfaces to enhance heat dissipation.

NOTE: When planning system space requirements, allow at least 6 inches past system total length wherever a terminal plate assembly is to be located. (See Figure 1A)

Figure 1 A-B are typical. For total length, width and height dimensions of connected systems, consult layout/wiring diagram for the particular system.

5.2 Battery Location & Ambient Temperature Requirements

It is recommended that the battery unit be installed in a clean, cool, dry location. Floors should be level. Absolyte batteries can be installed in proximity to electronic equipment.

A location having an ambient temperature of 75°F (24°C) to 77°F (25°C) will result in optimum battery life and performance. Temperatures below 77°F (25°C) reduce battery charge efficiency and discharge performance. Temperatures above 77°F (25°C) will result in a reduction in battery life (see table below.)

Annual Average Battery Temperature	Maximum Battery Temperature	Percent Reduction In Battery Life
77°F (25°C)	122°F (50°C)	0%
86°F (30°C)	122°F (50°C)	30%
95°F (35°C)	122°F (50°C)	50%
104°F (40°C)	122°F (50°C)	66%
113°F (45°C)	122°F (50°C)	75%
122°F (50°C)	122°F (50°C)	83%

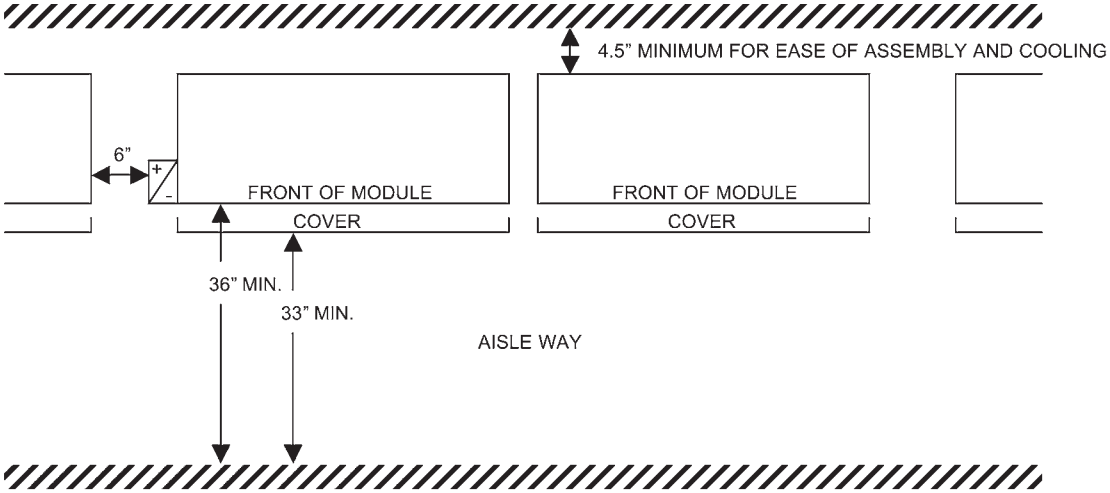


FIGURE 1A - HORIZONTAL END TO END

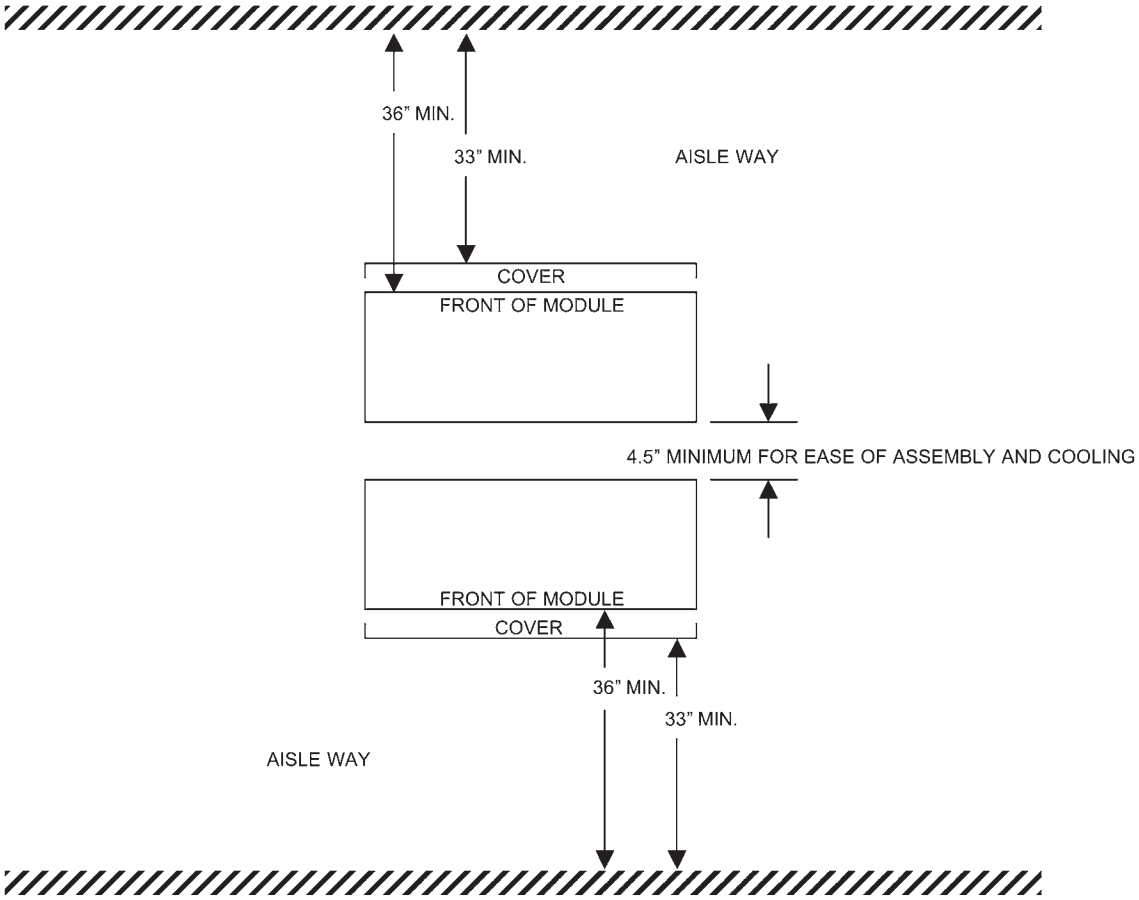


FIGURE 1B - HORIZONTAL BACK TO BACK

FIGURE 1 - TYPICAL SYSTEMS (TOP VIEW)

For example: If a battery has a design life of 20 years at 77°F (25°C), but the actual annual average battery temperature is 95°F (35°C), the projected service life of the battery is calculated to be only 10 years.

Temperature records shall be maintained by the user in accordance with the maintanence schedule published in this manual. The battery temperature shall not be allowed to exceed the maximum temperature shown above. It is important to maintain the battery temperature as close to 77°F (25°C) as possible to achieve the optimum service life from your battery.

5.3 Temperature Variations

Sources of heat or cooling directed on portions of the battery can cause temperature variations within the strings, resulting in cell voltage differences and eventual compromise of battery performance.

Heat sources such as heaters, sunlight or associated equipment can cause such temperature variations. Similarly, air conditioning or outside air vents may cause cell string temperature variations. Every effort should be made to keep temperature variations within 5°F (3°C).

5.4 Ventilation

The Absolyte battery is a Valve Regulated Lead Acid (VRLA) low maintenance design. Tests have confirmed that under recommended operating conditions in stationary applications, 99% or more of gases generated are recombined within the cell. In most cases, no special ventilation and or battery room is required. Consult your local building and fire codes for requirements that may apply to your specific location.

Hydrogen and oxygen gases can be vented to the atmosphere under certain conditions. Therefore, the battery should never be installed in an air-tight enclosure. Sufficient precautions must be taken to prevent excessive overcharge.

5.5 Floor Loading

The floor of the area where the battery system is to be installed should have the capability of supporting the weight of the battery as well as any auxiliary equipment. The total battery weight will depend on the cell size, number of cells, as well as module configuration involved. Prior to installation, a determination should be made that the floor integrity is adequate to accommodate the battery system.

5.6 Floor Anchoring

Where seismic conditions are anticipated, floor anchoring must be implemented.

Where non-seismic conditions are anticipated, anchoring of horizontally stacked systems is recommended for maximum stability.

Four 9/16" (14.3 mm) holes are provided in each I-Beam support for anchoring. To maintain seismic certification, use four anchor bolts per horizontal support. Anchor design is the responsibility of the purchaser/installer.

5.7 Connecting Cables: Battery System to Operating Equipment

The Absolyte cell is a UL recognized component.
Battery performance is based on the output at the battery terminals. Therefore, the shortest electrical connections between the battery system and the operating equipment results in maximum total system performance.

DO NOT SELECT CABLE SIZE BASED ON CURRENT CARRYING CAPACITY ONLY. Cable size selection should provide no greater voltage drop between the battery system and operating equipment than necessary. Excess voltage drop will reduce the desired support time of the battery system.

5.7.1 Paralleling

Where it is necessary to connect battery strings in parallel in order to obtain sufficient load backup time, it is important to minimize the difference in voltage drop between the battery strings in parallel in order to promote equal load sharing upon discharge. Therefore, equal resistance of cable connections for each parallel string is important. When paralleling multiple strings to a load or common bus, please follow these guidelines:

- Each parallel string must have the same number of cells (same string voltage).
- The cables connecting the positive and negative terminals of each string to the load (or bus) should be of the **SAME SIZE** (i.e. same capacity/cross-sectional area).
- The cables connecting the positive and negative terminals of each string to the load (or bus) should be of the **SAME LENGTH**. Choose the shortest cable length that will connect the battery string that is furthest from the load, and cut all cables used to connect each string to the load to this same length.

5.8 Stacking Limitations

There are recommended limits on stacked battery configurations. Please refer to Appendix D for additional information. NOTE: Horizontal module arrangement only.

5.9 Terminal Plates

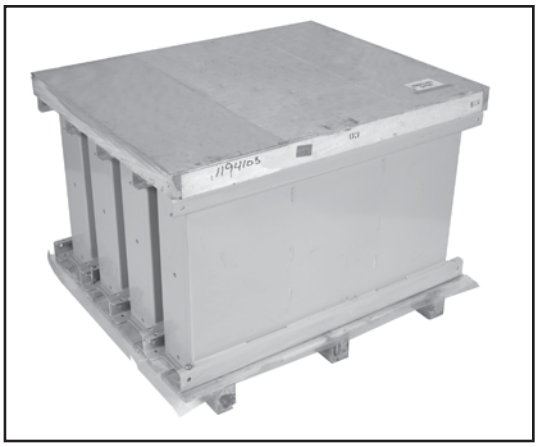
Each system is supplied with a terminal plate assembly for the positive and negative terminations. These should always be used to provide proper connection to the operating equipment and cell terminals. Any attempt to connect load cables directly to cell terminal may compromise battery system performance as well as the integrity of cell post seals.

5.10 Grounding

It is recommended that the modules or racks be grounded in accordance with NEC and/or local codes. See Appendix C for recommended procedure.

SECTION 6

6.0 Unpacking and Handling



PACKED MODULES
Figure 2

6.1 General

Do not remove shipping materials if a storage period is planned, unless charging is required per Section 4.2.

The battery modules are generally packed in groups. Lag bolts retain the modules to the shipping pallet together with a protective hood bolted in place. Modules are also bolted together at the top adjacent channels. See Figure 2.

6.2 Accessories

Accessories are packed separately and will include the following: (**Note:** Some items may not be provided depending on battery configuration).

- Layout/wiring diagram
- Installation and operating instructions
- Lifting straps and lifting shackles
- Protective covers and hardware
- Terminal plate assembly kits and covers
- Module tie plates (where required) (i.e. side-by-side stacks)
- Vertical or horizontal supports (i.e. I-beams)
- Lead-Tin Plated copper intercell connectors
- Assembly hardware
- NO-OX-ID® "A"* grease
- Battery warning label
- Battery nameplate
- Cell numerals with polarity indicators
- Shims (leveling)
- Drift pins
- Seismic Shims (where required). Included with systems containing stacks of 7 or more modules in height.

*Registered Trademark of Sanchem Inc.

NOTE: Check battery components against supplied drawings to assure completeness. Do not proceed with installation until all accessory parts are available.

6.3 Recommended Installation Equipment and Supplies

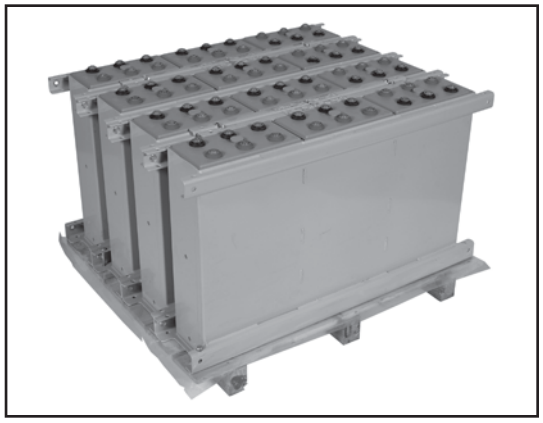
- Fork lift or portable boom crane
- Chalk line
- Line Cord
- Torpedo level (Plastic)
- Plywood straight edge 1/2" x 4" x 48"
- Torque wrenches
- Ratchet wrench with 10, 13, 17, 19 mm sockets and 2 and 15 mm deep sockets
- Box wrenches of 10, 13, 15, 17 and 19 mm sizes
- Vinyl electrical tape
- Paper wipers
- 3M Scotch Brite® scour-pads™†
- Hammer drill (floor anchoring)

† Trademark of 3M

6.4 Unpacking

Carefully remove bolts and protective shipping hood. See Figure 3. Remove the bolts holding modules to shipping pallet. Also remove hardware bolting upper channels of modules together. Do not remove modules at this time. Base supports for horizontally stacked modules are more easily attached before removing modules from pallet (see Section 8.0 System Assembly and Section 9.0 Connections).

Note: Placement of modules on shipping pallet has no relationship to final installation.



UNPACKING MODULES
Figure 3

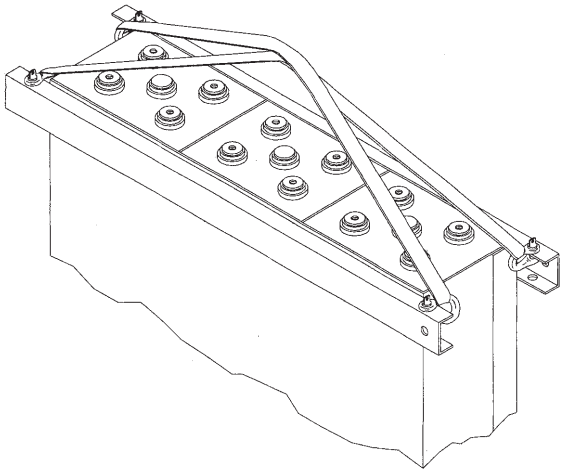
6.5 Handling

The design of the modular tray permits handling by a fork lift, portable crane or by a hoist sling (see Figure 4). Whichever method is used, make sure equipment can safely handle the module weight.

Always use the two lifting straps and four lifting shackles for lifting and placement of modules.

CAUTION!

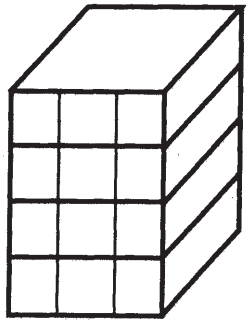
If a fork lift or portable crane is used to handle modules in a horizontal position, a piece of insulating material such as heavy cardboard, rubber insulating mats or plywood should be used between handling equipment and module tops to prevent shorting of module top connections with metal parts of lift equipment.



NOTE:

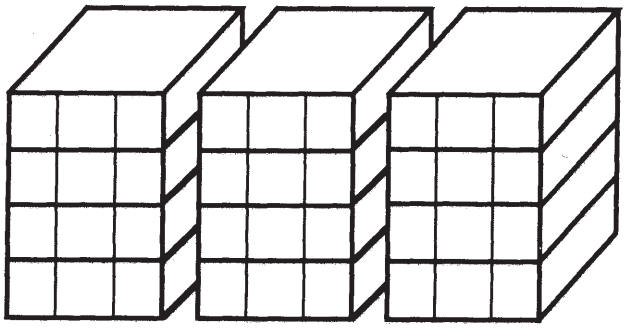
1) Straps must be criss-crossed.
2) Lifting shackle orientation and proper channel hole use must be observed.
3) See Figure 14 for handling modules in horizontal orientation.
4) Never lift more than two joined modules with straps and hooks.

HANDLING - LIFTING STRAP PLACEMENT
Figure 4



HORIZONTAL
SINGLE STACK

Figure 6A



HORIZONTAL
MULTIPLE STACKS
END TO END

Figure 6B

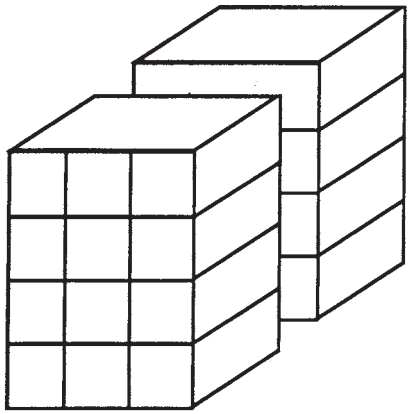
SECTION 7

7.0 System Arrangements

7.1 Module Arrangements

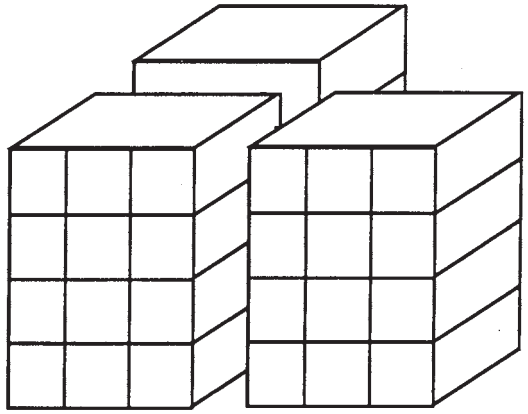
Absolyte batteries are recommended for installation in a horizontal orientation only. However, vertical installation is approved for 50G systems consisting of single cell modules. Figures 6 and 7 are typical arrangements and are not intended to represent all configuration possibilities.

Module stack height limitation depends on cell size and the seismic requirements of the application. Please refer to Appendix D for additional information.



HORIZONTAL SINGLE STACK BACK TO BACK

Figure 6C



HORIZONTAL MULTIPLE STACKS
BACK TO BACK AND END TO END
TYPICAL HORIZONTAL STACK ARRANGEMENTS
Figure 7

7.2 Dummy Cells within a Module

Where application voltage requires, a dummy cell can replace a live cell in a module. For example, a 46 volt, three-cell per module system may consist of seven full modules and one module containing two live cells and either an empty space, or a dummy cell.

SECTION 8

8.0 System Assembly

8.1 Horizontal Single Stack

Consult layout/wiring diagram for total number and type of module assemblies in system. There can be varying combinations of cell arrangements within the module. May contain dummy cells depending on total system voltage.

Compare required module assemblies called for on layout/wiring diagram with modules in shipment for completeness before continuing further.

8.1.1 Bottom I-beam Supports

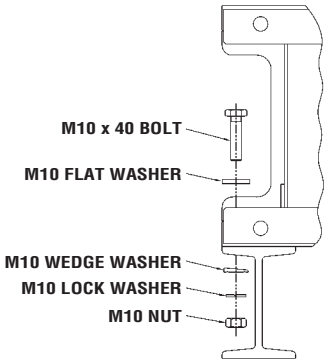
Locate bottom I-beam supports and M10 I-beam hardware kit. I-beam supports and seismic shims should be attached to the appropriate module assembly shown on the layout/wiring diagram prior to removal from shipping pallet.

NOTE: Seismic shims will be supplied with systems for which they are required to maintain seismic compliance.

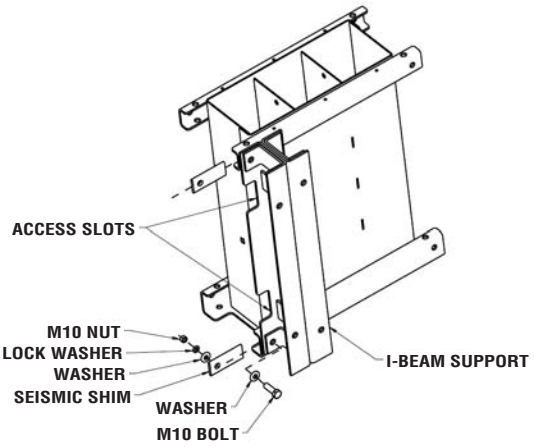
Secure I-beam support to a module channel as shown in supplied drawing, with access slots outward. Please refer to Figure 8 and 9 for general hardware installation information. Seismic shims, when supplied, are placed between the channel and the nut and oriented so as to not extend beyond the end of the channel. Torque hardware to 47 Newton-meters (35 ft-lbs) using insulated tools. When correctly attached, the I-beam support will be flush with the front module channel and approximately 13mm (0.50") away from the back of the module. The side of the I-beam support will be approximately 10mm (0.38") away from the end of the channels.

NOTE: The use of leveling shims is required when assembling any Absolyte system in order to meet seismic requirements. Failure to use the shims to level each module and to fill spaces between tray channels during module assembly will result in the assembly not meeting seismic certification criteria.

Similarly, install the remaining I-beam support on the other side of the module (see Figure 10).



HARDWARE INSTALLATION FOR 2.67" WIDE I-BEAM SUPPORT
Figure 8



HARDWARE INSTALLATION FOR 4.5" WIDE I-BEAM SUPPORT
Figure 9

COMPLETED I-BEAM SUPPORT TO MODULE INSTALLATION
Figure 10

8.1.2 Handling

The module/base support assembly may now be removed from the pallet using methods outlined in section 6.5, Handling. Also see Figure 11. Remaining modules may be removed in a similar manner.

8.1.3 Horizontal Stacking

In order to stack modules in the horizontal position, refer to Figures 11 thru 13 to perform the tip-over procedure. The module/base support assembly tip-over should be performed first. This procedure can be performed using a portable boom crane or fork lift in conjunction with the lifting straps and lifting shackles supplied.

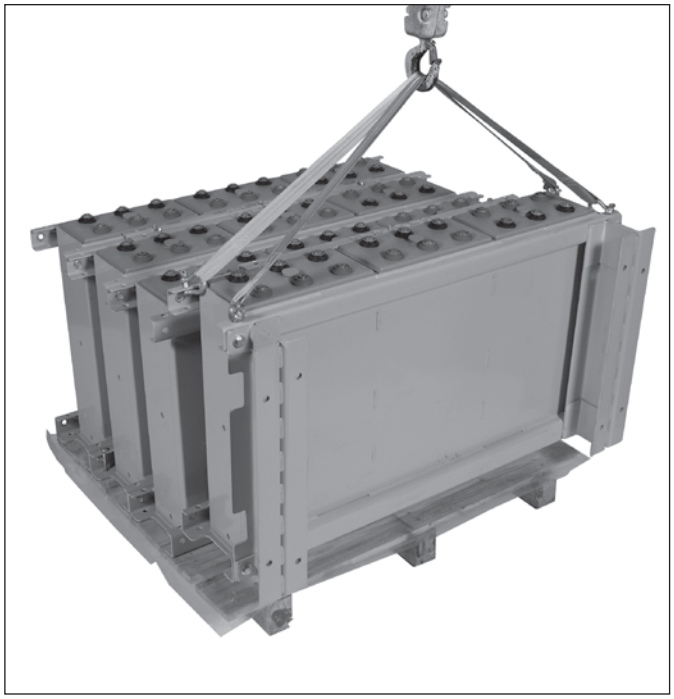
CAUTION!
DO NOT ATTEMPT TO PERFORM TIP-OVER OF MODULE MANUALLY AS SERIOUS PERSONAL INJURY AND MODULE DAMAGE MAY RESULT.

A. Install lifting strap using lifting shackles in channel base holes at each end of module upper rear channel as shown in Figure 12A.

B. Center the lifting hook onto strap and lift until strap is under tension and raises bottom of module from floor surface so that upper and lower diagonal corners are in a vertical mode.

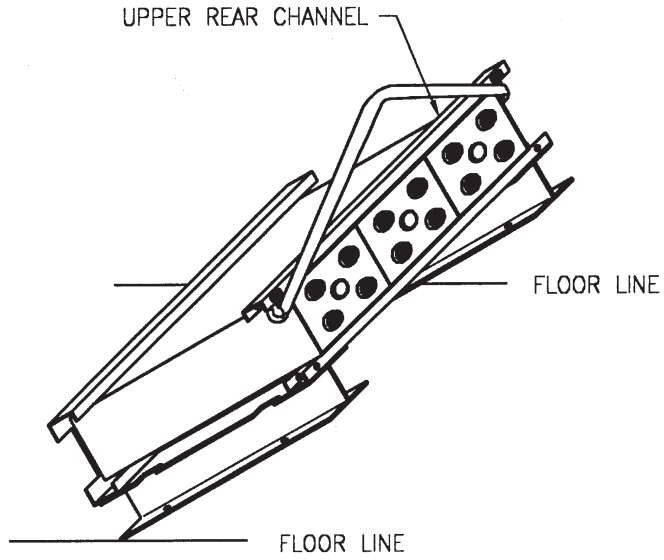
C. While exerting manual force on the upper rear of module, lower hoist until module is in horizontal position. See Figures 12B and 13.

D. When module is horizontal, install the four lifting shackles and two lifting straps as shown in Figure 14.



HANDLING MODULE - BASE SUPPORT ASSEMBLY
Figure 11

E. Where floor anchoring is required, position module/base assembly in desired location. Mark floor through I-beam holes and remove module/base assembly. Install floor anchoring and reposition module/base assembly over anchoring. Prior to installing nuts and washers, check that assembly is level in both axes. Level using shims provided. Torque anchor hardware to manufacturer's recommended value.



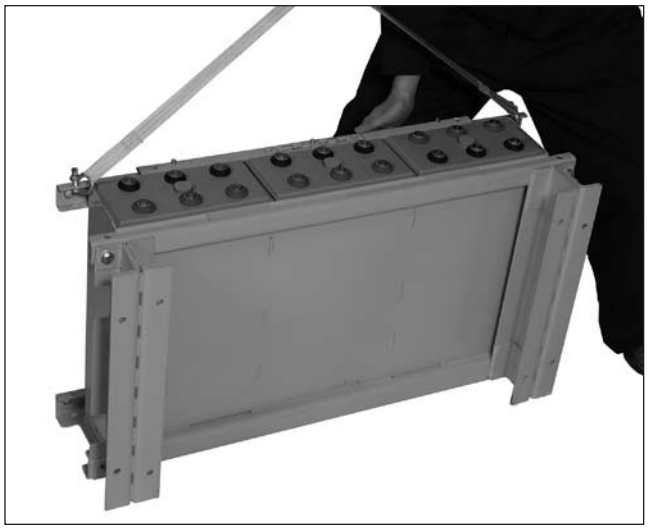
NOTE:

1) One strap with shackles used for tip-over procedure.
2) Observe channel hole used as well as direction of shackle insertion.
3) Tip over procedure for single modules only.

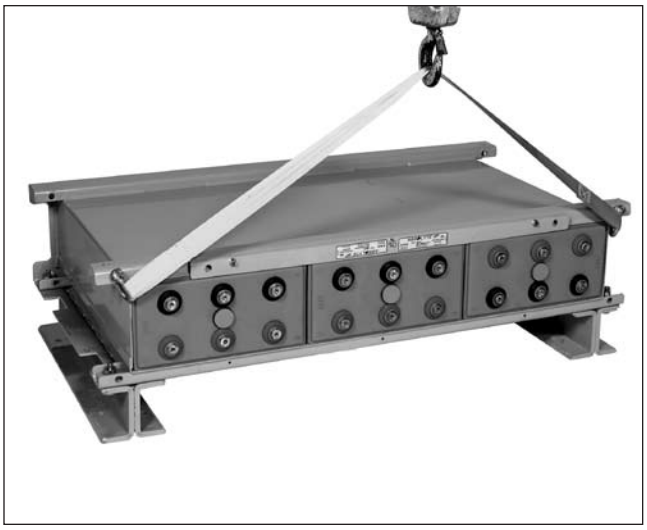
TIP OVER PROCEDURE
SHACKLE-STRAP USAGE
Figure 12A

F. Using Steps A-D and the layout/wiring diagram, position the next module on top of first so that channels of each mate with one another using drift pins to align channel holes. Make sure channel ends and sides of the upper and lower modules are flush. Install serrated flange bolts and nuts in open holes, finger tight. Remove lifting straps. Use leveling shims to fill gaps between trays. See Figures 15, 16, and 17A.

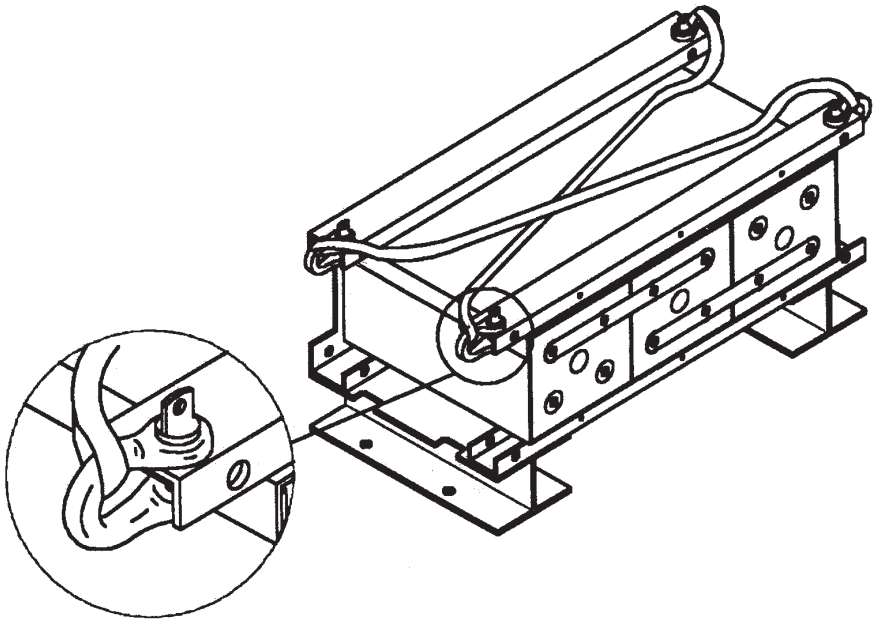
G. At this time, check to see that the first two modules are plumb front to back and side to side using wooden or plastic level together with plywood straight edge. This is to insure proper alignment for module interconnection later on. Torque hardware to 47 Newton-meters (35 Ft-Lbs).



TIP-OVER PROCEDURE
Figure 12B



MODULE WITH BASE ASSEMBLY
AFTER TIP-OVER
Figure 13

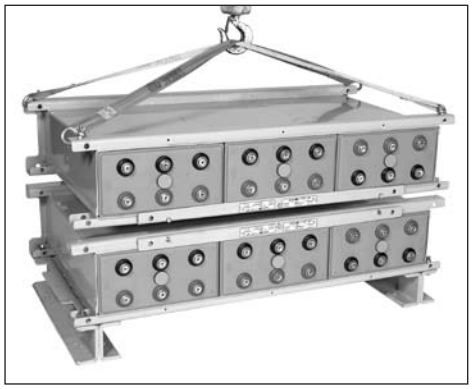


NOTE:

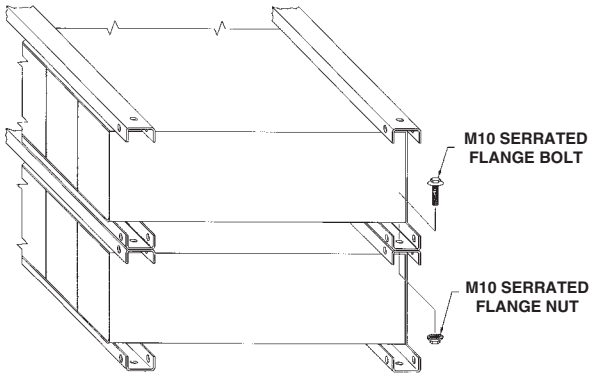
1) Straps must be criss-crossed
2) Lifting shackle orientation and proper channel hole use must be observed.
3) See Figure 4 for handling modules in vertical orientation.
4) Lift single modules only.

HORIZONTAL STACKING SHACKLE-STRAP USAGE
Figure 14

H. Proceed with stacking of remaining modules, checking that stack is plumb in both axes as stacking progresses before torquing hardware. Be certain to check the layout/wiring diagram for correct horizontal orientation to provide proper polarity interconnection as stacking progresses. See Figure 17B.



HANDLING AND STACKING HORIZONTAL MODULES
Figure 15



HARDWARE INSTALLATION SEQUENCE
Figure 16

INSTALLING HARDWARE
Figure 17A

COMPLETED HORIZONTAL STACK
Figure 17B

8.2 Horizontal-Multiple Stacks

It is recommended that all of the first modules with bottom supports attached (see Section 8.1.1) be placed in position first. A chalk line floor mark should be used to assure all stacks will be in a straight line. This applies for stacks end-to-end or end-to-end and back-to-back. Also refer to Section 8.1.3, Items A through H (Item E for base module leveling).

Module ends should be butted together so that module side channel ends meet (see Figure 18).

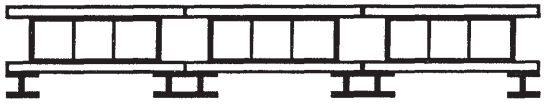
Refer to layout/wiring diagram for seismic shim requirements.

At this time stack tie plates should be installed (see Section 8.2.1). It will be necessary to temporarily remove the hardware fastening the base modules to the I-beams.

See Figure 20A. Install tie plates and hardware. Torque to 47 Newton-meters (35 Ft-Lbs).

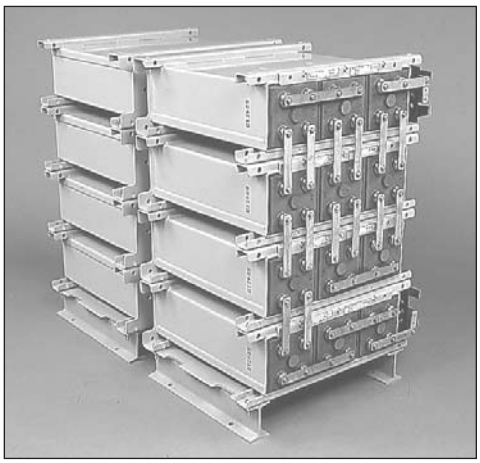
For stacks back-to-back, the two base modules are positioned to provide a minimum 4.5" spacing between the bottoms of the modules (not I-beam edges). See Figure 19A.

When all base modules are set in place, continue with stacking of subsequent modules. Procedures for assembly of multiple horizontal stacks are the same as outlined in section 9.1. Also consult layout/wiring diagram. Each stack should be built up in sequence to the same level until the top modules in all stacks are the last to be installed. The use of a line cord attached to upper module corners of opposite end modules as stacking progresses aids in alignment. See Figure 19B.

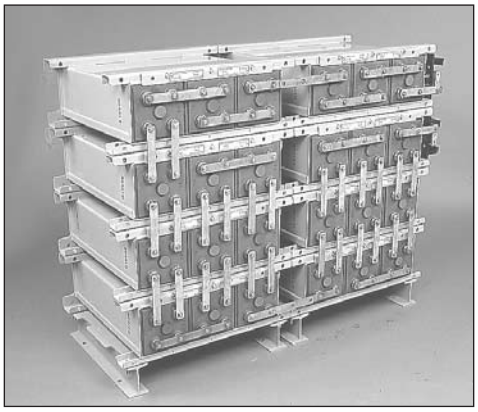


Note:
1) Level modules beneath I-beams in both axes to achieve proper interfacing of channel ends and installation of inter-stack connectors.

POSITIONING HORIZONTAL BASE MODULE
Figure 18

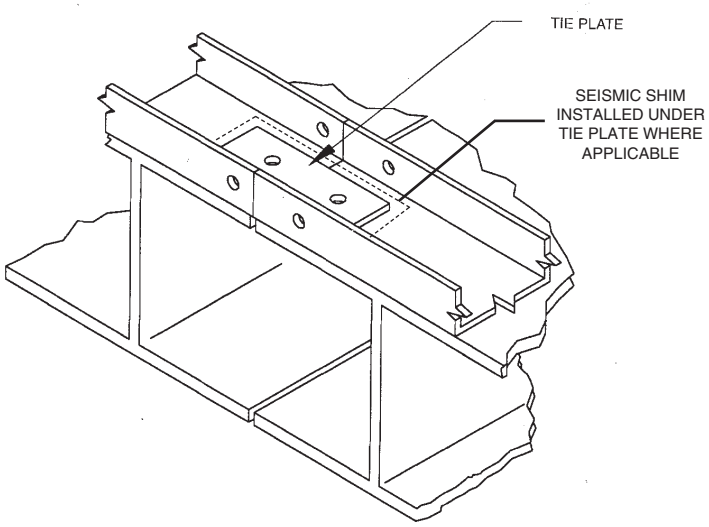


HORIZONTAL STACKS — BACK TO BACK POSITIONING
Figure 19A



COMPLETED HORIZONTAL STACKS — SIDE BY SIDE
Figure 19B

TYPICAL ASSEMBLY FOR BOTTOM MODULES
HARDWARE AND SEQUENCE OF
ASSEMBLY SAME AS 20B



TIE PLATE BOTTOM MODULES
Figure 20A

8.2.1 Stack Tie Plate

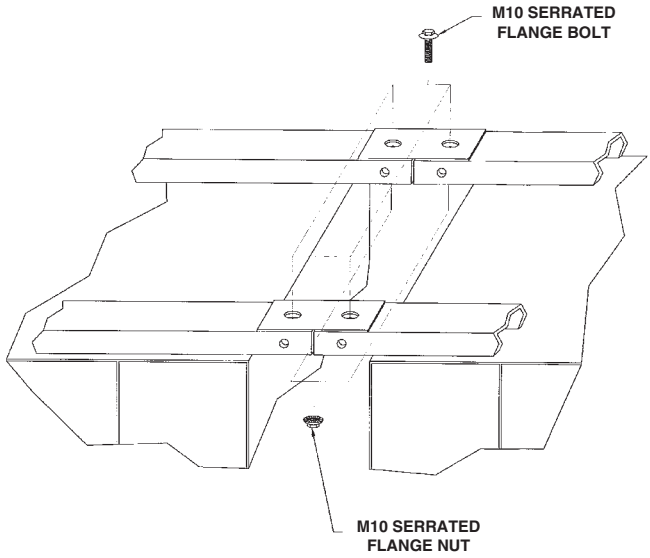
To achieve maximum stack stability, especially where seismic conditions may exist, as well as proper interfacing of inter-stack connections, metal tie plates are provided. The plates used on stacks end to end are 3” x 1” x 1/8” with two 9/16” holes. Use one tie plate at each interface on only the base and top modules of adjacent stacks. See Figures 20A and 20B.

Position plates on the front and back channels and secure with hardware shown. Where stacks have different levels, install plates on shorter stack top module and adjacent module. Torque hardware to 47 Newton-meters (35 Ft-Lbs).

This completes the mechanical assembly of the battery system.

For installation of connections and terminal plate assembly, see Section 9.

For installation of protective module cover, see Section 10.



TIE PLATE TOP MODULES
Figure 20B

SECTION 9

9.0 Connections

9.1 Post Preparation

Using either a brass bristle suede shoe brush or 3M Scotch Brite scouring pad, brighten the flat copper terminal surfaces to ensure lowest resistance connections.

Apply a thin film of NO-OX-ID “A” grease (supplied with battery) to all terminal mating surfaces. This will preclude oxidation after connections are completed.

9.2 Connections - System Terminals

Each system is supplied with a terminal plate assembly for the positive and negative terminations. These should always be used to provide proper connection to the operating equipment and cell terminals. Any attempt to connect load cables directly to cell terminals may compromise battery system performance as well as the integrity of cell post seals.

For terminal plate assembly, see Figure 22 (6 cell modules at low rate) or Figure 23. Consult layout/wiring diagram for proper kit use. It is recommended that all components be assembled in place with hardware torqued to 11.3 Newton-meters (100 in-lbs). Retorque value is also 11.3 Newton-meters (100 in-lbs).

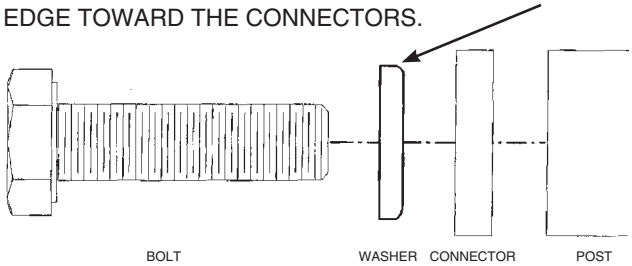
Refer to Sections 9.1 and 9.3 for electrical contact surface preparation of terminal plate components.

As shown, terminal plate assembly can be varied to satisfy module terminal location as well as orientation of terminal plate in a horizontal or vertical plane. **Do not make connections to operating system at this time.**

9.3 Connections - INTER-Module

Consult layout/wiring diagram for correct quantity of lead-tin plated copper connectors required at each connection. Follow procedure in Section 9.1 and brighten lead-tin plated surfaces coming in contact with copper posts. Apply a film of NO-OX-ID “A” grease to these areas. NOTE: Apply a minimum amount of grease to cover the surface. As a rule: “If you can see it, it’s too much”. Where multiple connectors are required across any single connection, brighten both sides of connectors along the entire length. Grease these areas as well. It is recommended when installing connectors that the upper bolts be installed first to reduced risk of accidental shorting.

WASHERS SHOULD BE INSTALLED WITH THE CURVED EDGE TOWARD THE CONNECTORS.



Cells are interconnected with connectors and hardware as shown in Figures 21A and 21B

9.4 Connections - INTER-Stack

Multiple stacks end to end are interconnected as shown in Figure 21C and 21D. Follow procedures in Section 9.1 and Section 9.3. Also see Section 9.5, Connections - Torquing.

9.5 Connections - Torquing

When all inter-module connections have been installed, tighten all connections to 11.3 Newton-meters (100 in-lbs) Use insulated tools. All connections should be rechecked after the initial charge, due to heating during charge.

9.6 Connection - Check

Again, visually check to see that all module terminals are connected positive (+) to negative (-) throughout the battery.

Also measure the total voltage from terminal plate to terminal plate. This should be approximately equal to 2.15 volts times the number of cells in the system, e.g., a 24 cell system would read: 24 x 2.15v = 51.6 volts.

9.7 Connection Resistance

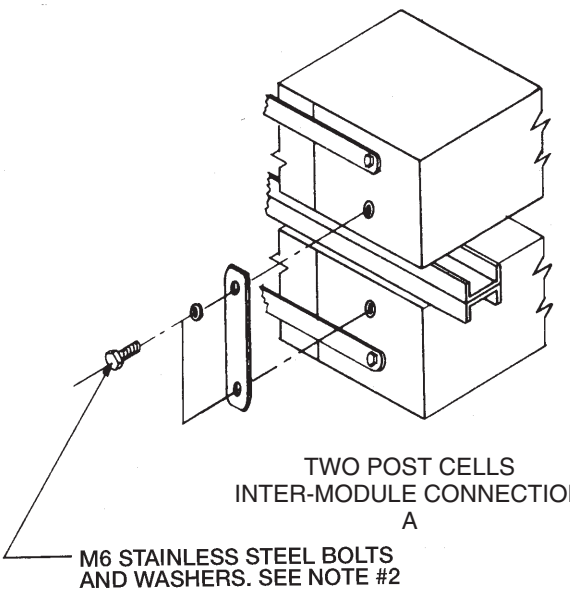
Electrical integrity of connections can be objectively established by measuring the resistance of each connection. These resistances are typically in the microhm range. Meters are available which determine connection resistance in microhms. Be sure that the probes are touching only the posts to ensure that the contact resistance of connector to post is included in the reading.

Resistance measurements or microhm measurements should be taken at the time of installation and annually thereafter. Initial measurements at installation become the bench mark values and should be recorded for future monitoring of electrical integrity.

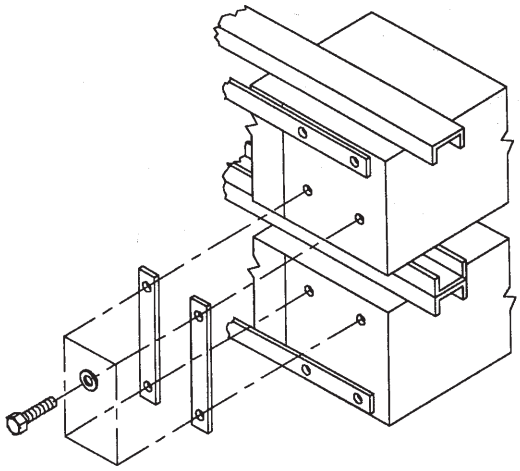
It is important that the bench mark value for all similar connections be no greater than 10% over the average. If any connection resistance exceeds the average by more than 10%, the connection should be remade so that an acceptable bench mark value is established.

Bench mark values for connection resistances should also be established for terminal plates, where used, as well as cable connections. Bench mark values should preferably be established upon installation.

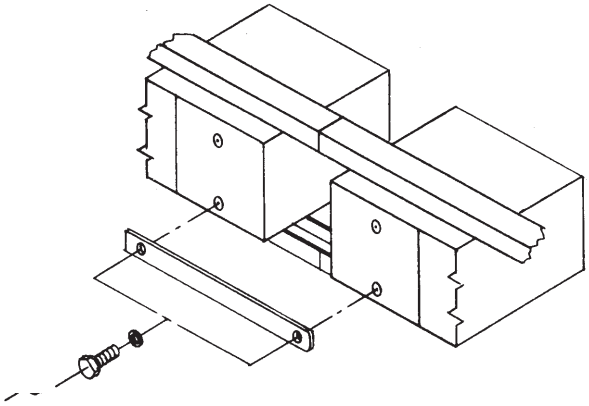
All bench mark values should be recorded. Annually, all connection resistances should be re-measured. Any connection which has a resistance value 20% above its benchmark value should be corrected.



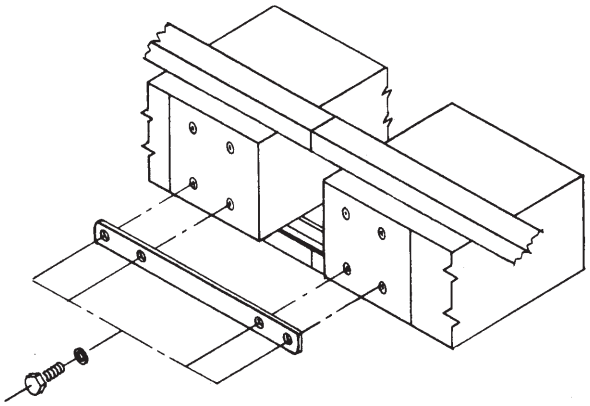
TWO POST CELLS
INTER-MODULE CONNECTION
A



FOUR POST CELLS
INTER-MODULE CONNECTION
B



TWO POST CELLS
INTER-STACK CONNECTION
C



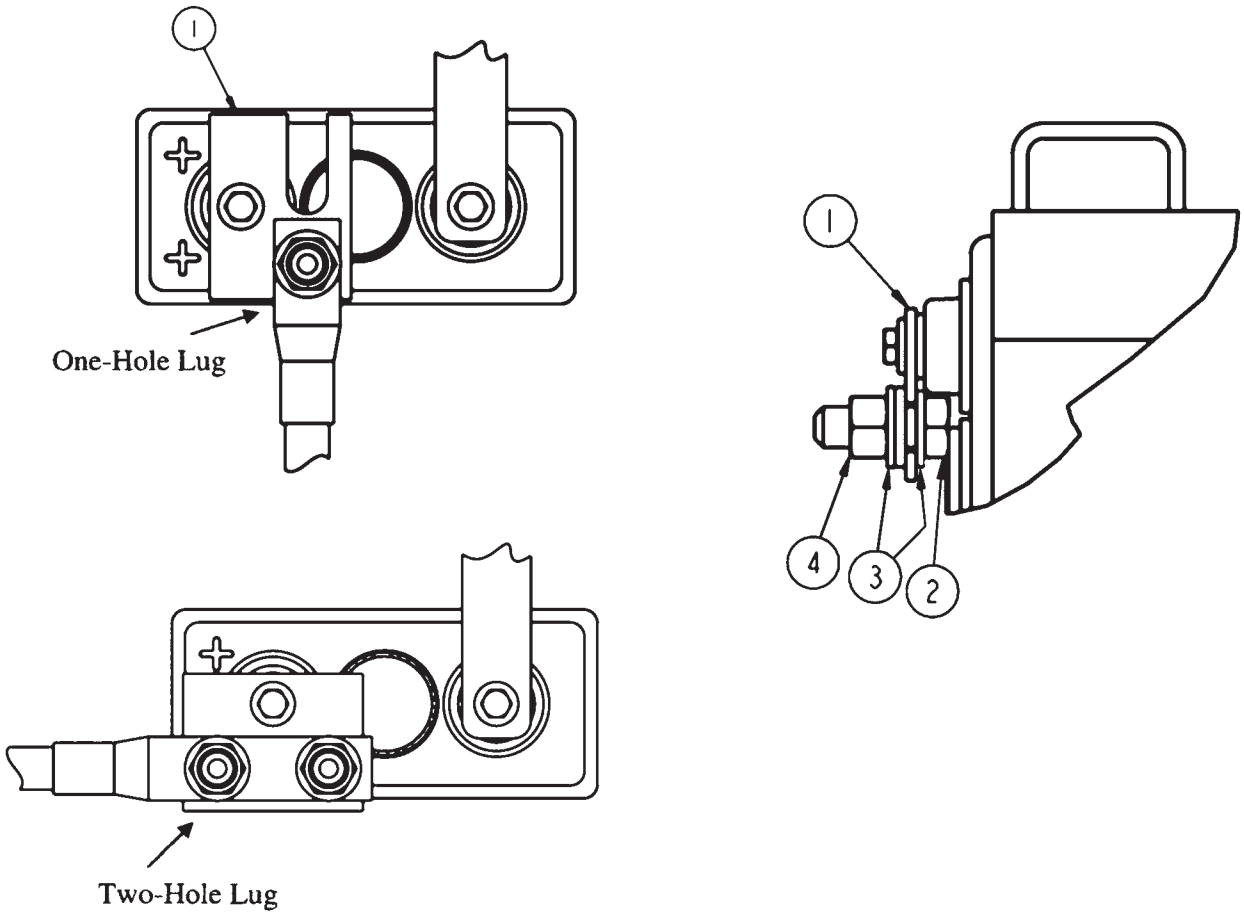
FOUR POST CELLS
INTER-STACK CONNECTION
D

Note:

1) See Section 9 - Connections
2) Torque hardware to 11.3 Newton-meters (100 in-lbs).
3) Consult layout/wiring diagram received with battery system
4) Curved edge of washer should face the connector.

VARIOUS INTER STACK AND
INTER-MODULE CONNECTIONS
HORIZONTAL ARRANGEMENTS

Figure 21

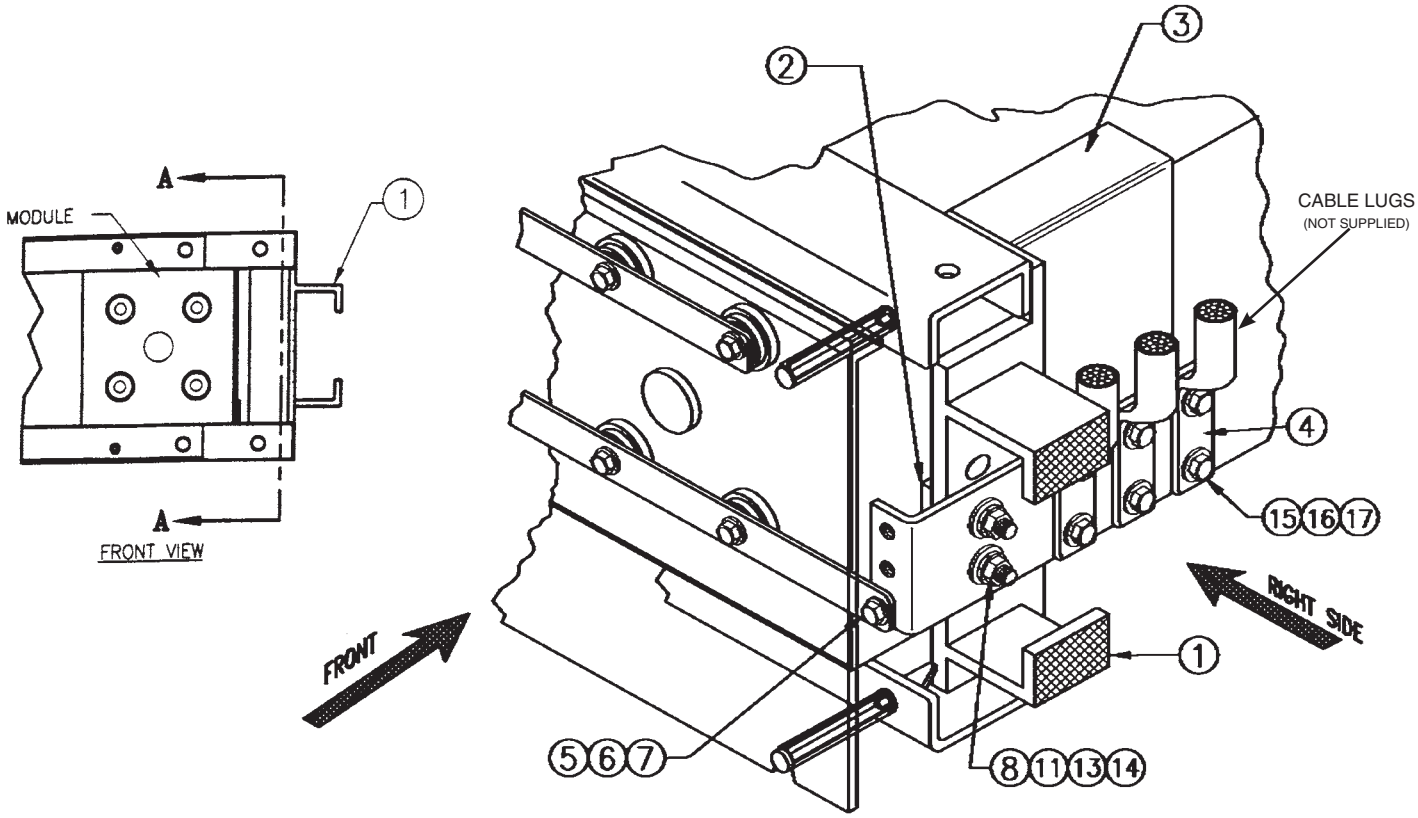


ITEM	PART DESCRIPTION	MATERIAL	QTY.
1	TERMINAL PLATE	LEAD PL. COPPER	1
2	BOLT M12 - 30	STAINLESS STEEL	2
3	WASHER - FL 13.0 X 24.0 X 2.5	STAINLESS STEEL	4
4	NUT M12 X 8d	STAINLESS STEEL	2

* Quantity shown is for <u>one</u> terminal plate assembly.

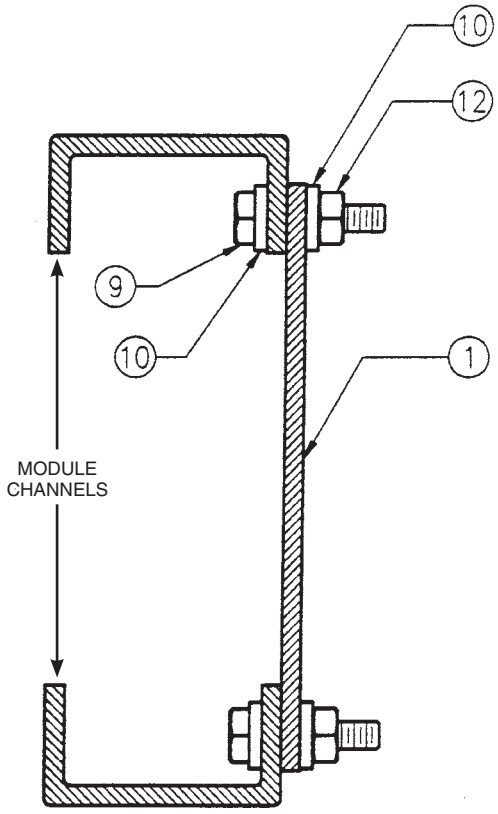
TERMINAL PLATE KIT
6 CELL MODULES
LOW RATE - 3 HOURS OR LONGER BACK-UP
K17-417002

Figure 22



ITEM	PART DESCRIPTION	MATERIAL	QTY.*
1	TERMINAL PLATE MOUNTING BRACKET	POLYMER	1
2	BACKING PLATE SUPPORT	PAINTED STEEL	1
3	TRAY INSULATING SHIELD	POLYMER	1
4	TERMINAL PLATE	COPPER LP	1
5	M6 X 25 BOLT	STAINLESS	2
6	M6 X 3 FLAT WASHER	STAINLESS	4
7	M6 NUT	STAINLESS	2
8	M10 X 40 BOLT	STAINLESS	2
9	M8 X 30 BOLT	STAINLESS	2
10	M8 X 2 FLAT WASHER	STAINLESS	4
11	M10 X 4 FLAT WASHER	STAINLESS	4
12	M8 NUT	STAINLESS	2
13	M10 LOCK WASHER	STAINLESS	2
14	M10 JAM NUT	STAINLESS	2
15	M12 X 40 BOLT	STAINLESS	6
16	M12 X 2.5 FLAT WASHER	STAINLESS	12
17	M12 NUT	STAINLESS	6

* QUANTITY SHOWN IS FOR ONE TERMINAL PLATE ASSEMBLY.



SECTION A–A
PARTIAL RIGHT SIDE VIEW

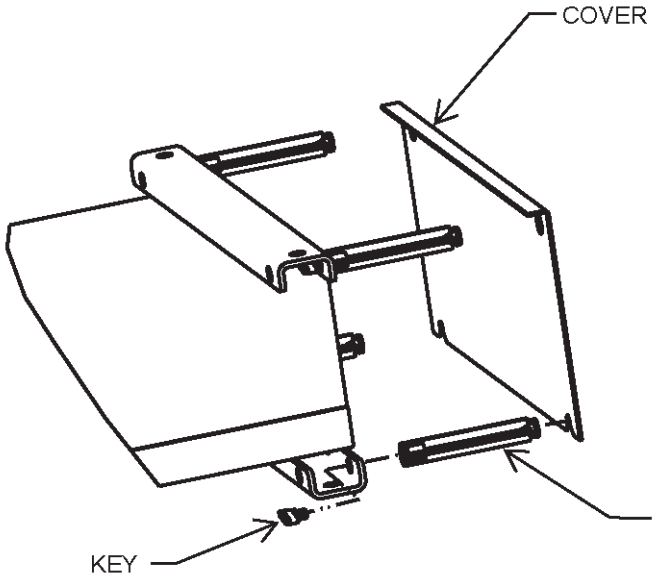
TERMINAL PLATE KIT
K17–417003

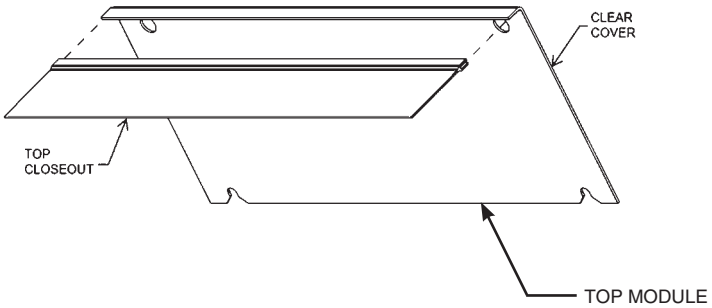
Figure 23

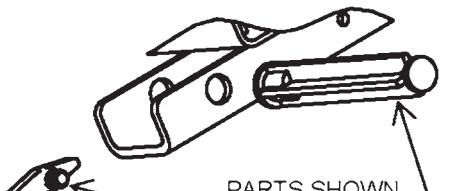
TO ASSEMBLE THE ABSOLYTE GP MODULE COVER, THE FOLLOWING ARE NEEDED:

ITEM	QUANTITY
CLEAR COVER	1
STANDOFF LEG	4
KEY	4
TOP CLOSEOUT	1*

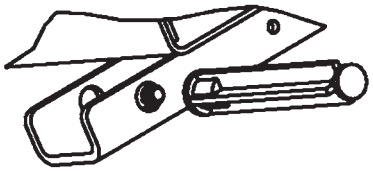
*TOP MODULE COVER ONLY



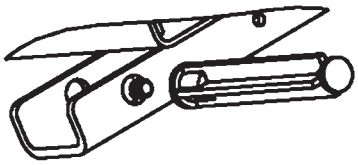




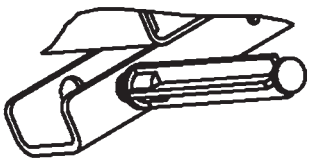
1



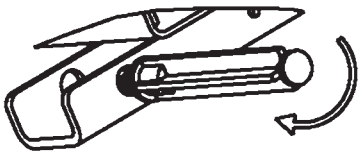
2 KEY THREADS ARE INSERTED INTO THE HOLE IN THE CHANNEL



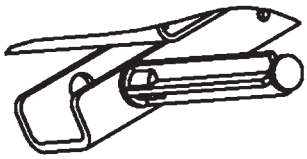
3 KEY IS PUSHED INTO THE CHANNEL HOLE, KEY SHANK KEEPS IT CENTERED



4 STANDOFF LEG IS PARTIALLY THREADED ONTO THE KEY: STILL TWO HANDS USED



5 LET GO OF THE KEY: TURN LEG CLOCKWISE: KEY WILL ROTATE UNTIL IT HITS THE CHANNEL



6 KEEP TURNING THE LEG UNTIL IT TIGHTENS -- DO NOT OVER TIGHTEN

7 INSTALL TOP CLOSEOUT ON TO CLEAR COVER OF TOP MODULE: CUT TO ALLOW FOR TERMINAL PLATE AS REQUIRED

8 INSTALL COVERS ONTO STANDOFF LEGS.

INSTALLATION GUIDE FOR ABSOLYTE GP MODULE COVER

Figure 24

9.8 Cell Numerals

A set of pressure sensitive cell numerals and system polarity labels are supplied and should be applied at this time.

Cell numerals should be applied to the top of the module and as close to the cell being identified as possible. Suggest application to cell restraint bars or to module channels. Designate the positive terminal cell as #1 with succeeding cells in series in ascending order.

The system polarity labels should be applied next to the positive and negative terminals.

9.9 Warning Label

Apply pressure sensitive warning label provided on a prominently visible module side or end (The module cover is recommended).

9.10 Battery Nameplate

For future reference and warranty protection, apply pressure sensitive nameplate on a prominently visible module. Fill in date of installation and the specified capacity and rate.

Make sure surfaces are free of dirt and grease by wiping with clean, dry wipers to ensure proper label adhesion.

For protective module cover installation, see Section 10.

SECTION 10

10.0 Protective Module Covers

Each module is provided with a transparent protective cover to help prevent accidental contact with live module electrical connections, and to provide easy visual access to the system.

When all system assembly has been completed, as well as initial testing including initial charge and cell float voltage readings, all covers should be installed. Covers should remain in place at all times during normal operation of the battery system.

10.1 Module Cover Installation

Refer to Figure 24 for installation of the transparent Module Covers. Install standoff legs and standoff keys first, as shown.

The cover is then installed by grasping it so that the EXIDE logo is upright. Locate slots at the bottom of cover to the bottom standoff legs and slide in place. Locate the holes at top of cover and install to top standoff legs.Refer to Figure 24.

SECTION 11

11.0 Initial Charge

Batteries lose some charge during shipment as well as during the period prior to installation. A battery should be given its initial charge at installation. Battery positive (+) terminal should be connected to charger positive (+) terminal and battery negative (-) terminal to charger negative (-) terminal.

Failure to perform the freshening charge within the limits stated in Section as well as failure to perform the initial charge upon installation of the battery 4 will affect the performance and life of the battery and may void the warranty.

11.1 Constant Voltage Method

Constant voltage is the only charging method allowed. Most modern chargers are of the constant voltage type.

Determine the maximum voltage that may be applied to the system equipment. This voltage, divided by the number of cells connected in series, will establish the maximum volts per cell (VPC) that is available.

Table B lists recommended voltages and charge times for the initial charge. Select the highest voltage the system allows to perform the initial charge in the shortest time period.

NOTE: Time periods listed in Table B are for 77°F. For other temperatures a compensation factor of .003 V/°F (.0055 V/°C) per cell is recommended. The minimum voltage is 2.20 VPC, temperature correction does not apply below this voltage.

TEMPERATURE CORRECTION

V corrected = V25°C - ((T actual-25°C) x (.0055V/°C)) or
V corrected = V77°F - ((T actual-77°F) x (.003V/°F))
See Appendix A for standard values.

STEP 1

A. Set constant voltage charger to maximum setting without exceeding 2.35 VPC. Example: For a target charge of 2.35 VPC on a 24-cell system, you would set the charger voltage to 56.4 volts.

   Depending on the battery's state of charge, the charger may go into current limit at the beginning and decline slowly once the target charge voltage is reached.

B. Record time and current at regular intervals – every hour as a minimum.

C. Continue charging the battery until there is no further drop in charge current over 3 consecutive hours. This could take days if the battery has been in storage for a long time.

D. When the current has stabilized, proceed to step 2.

STEP 2

A. Continue the charge for the time listed in Table B depending on the charger voltage setting. The time is IN ADDITION to the time spent charging in Step 1. Example, charge for 12 hours if the charger voltage is set to 2.35 VPC.

TABLE B

INITIAL CHARGE (77°F)	
CELL VOLTS	TIME-HRS (Minimum)
2.30	24
2.35	12

B. Record cell voltages hourly during the last 3 hours of the charge time. If, after the charge time has completed, but the lowest cell voltage has continued to rise, you may extend the charge, monitoring cell voltages hourly, until the lowest cell voltage ceases to rise.

C. Proceed to Step 3.

STEP 3

The initial charge is complete. Charger voltage can now be reduced to float voltage setting per Section 12.2. For a target float charge of 2.25 VPC on a 24-cell system, you would set the charger voltage to 54 volts.

SECTION 12

12.0 Operation

12.0.1 Cycle Method of Operation

In cycle operation, the degree of discharge will vary for different applications. Therefore, the frequency of recharging and the amount of charge necessary will vary. The amount of charge necessary depends on the number of ampere hours discharged. Generally, Absolyte GP cells require approximately 105-110% of the ampere-hours removed to be returned to achieve a full state of charge.

The upper voltage settings recommended, given that the maxium charge current is 5% of the nominal C_{100} Amp-hour rating and ambient temperatures of 25°C (77°F), are as follows:

2.28 ± 0.02 VPC @ 0-2% DOD
2.33 ± 0.02 VPC @ 3-5% DOD
2.38 ± 0.02 VPC @ >5% DOD

Due to the variety of applications and charging equipment (particularly in Photovoltaic systems) it is recommended that you contact an EXIDE representative when determining proper recharge profiles.

12.1 Floating Charge Method

In this type of operation, the battery is connected in parallel with a constant voltage charger and the critical load circuits. The charger should be capable of maintaining the required constant voltage at battery terminals and also supply a normal connected load where applicable. This sustains the battery in a fully charged condition and also makes it available to assume the emergency power requirements in the event of an AC power interruption or charger failure.

12.2 Float Charge - Float Voltages

Following are the float voltage ranges recommended for the Absolyte Battery System. Select any “volts per cell” (VPC) value within the range listed that will result in the series string having an average volts per cell equal to that value.

RECOMMENDED FLOAT RANGE (@77°F)
2.23 to 2.27 VPC

NOTE: Recommended float voltages are for 77°F. For other temperatures a compensation factor of .003 V/°F (.0055 V/°C) per cell is recommended. The minimum voltage is 2.20 VPC, temperature correction does not apply below this voltage. The maximum voltage is 2.35 VPC, temperature correction does not apply above this voltage.

TEMPERATURE CORRECTION

V corrected = V25°C - ((T actual-25°C) x (.0055V/°C)) or
V corrected = V77°F - ((T actual-77°F) x (.003V/°F))

See Appendix A for standard values.

Modern constant voltage output charging equipment is recommended for the floating charger method of operation of EXIDE Absolyte batteries. This type of charger, properly adjusted to the recommended float voltages and following recommended surveillance procedures, will assist in obtaining consistent serviceability and optimum life.

After the battery has been given its initial charge (refer to Section 11), the charger should be adjusted to provide the recommended float voltages at the battery terminals.

Do not use float voltages higher or lower than those recommended. Reduced capacity or battery life will result.

Check and record battery terminal voltage on a regular basis. Monthly checks are recommended. See Section 15.0, Records, second bullet. If battery float voltage is above or below the correct value, adjust charger to provide proper voltage as measured at the battery terminals.

12.3 Voltmeter Calibration

Panel and portable voltmeters used to indicate battery float voltages should be accurate at the operating voltage value. The same holds true for portable meters used to read individual cell voltages. These meters should be checked against a standard every six months and calibrated when necessary.

12.4 Recharge

All batteries should be recharged as soon as possible following a discharge with constant voltage chargers. However, to recharge in the shortest period of time, raise the charger output voltage to the highest value which the connected system will permit. Do not exceed the voltages and times listed in Table C, Section 13.2.

12.5 Determining State-of-Charge

If the normal connected load is constant (no emergency load connected), the following method can be used to determine the approximate state-of-charge of the battery. The state-of-charge can be identified to some degree by the amount of charging current going to the battery. When initially placed on charge or recharge following a discharge, the charging current, read at the charger ammeter, will be a combination of the load current plus the current necessary to charge the battery. The current to the battery will start to decrease and will finally stabilize when the battery becomes fully charged. If the current level remains constant for three consecutive hours, then this reflects a state-of-charge of approximately 95 to 98%. For most requirements, the battery is ready for use.

If the normal connected load is variable (i.e. telecommunications), the following method may be used to check the state-of-charge of the battery. Measure the voltage across a pilot cell (See Section 14.0 for definition of pilot cell). If the voltage is stable for 24 consecutive hours, the battery reflects a state of charge of approximately 95%.

12.6 Effects of Float Voltage

Float voltage has a direct effect on the service life of your battery and can be the cause of thermal instability.

A float voltage above the recommended values reduces service life. The chart below shows the effects of float voltage (temperature corrected) on battery life.

Temperature corrected 77°F (25°C) Float voltage per cell		Percent Reduction
Minimum	Maximum	in Battery Life
2.23	2.27	0%
2.28	2.32	50%
2.33	2.37	75%

Voltage records must be maintained by the user in accordance with the maintanence schedule published in this manual. To obtain the optimum service life from the battery, it is important to make sure the battery's float voltage is within the recommended range.

12.7 Float Current and Thermal Management

Increased float current can portend a condition known as thermal runaway, where the battery produces more heat than it can dissipate. VRLA batteries are more prone to thermal runaway because the recombination reaction that occurs at the negative plate, and reduces water loss, also produces heat. High room temperature, improper applications, improper voltage settings, and incorrect installation practices can increase the chances of thermal runaway.

As with good record-keeping practices, monitoring float current can prevent a minor excursion from becoming a major issue.

12.8 AC Ripple

AC ripple is noise or leftover AC waveform riding on the DC charge current to the battery that the rectifier did not remove. It is usually more pronounced in UPS than telecom systems. Proper maintenance of the UPS capacitors will reduce the amount of ripple going into the battery.

Establishment of absolute limits for AC ripple has always been problematic because the degree of damage it causes depends on the wave shape, peak-to-peak magnitude and frequency. Accurate characterization of AC ripple requires an oscilloscope and even then, only represents a picture of the ripple at that moment in time.

Whatever its exact characteristics, AC ripple is always harmful to batteries. Depending on its particular properties, ripple can result in overcharge, undercharge and micro-cycling that can prematurely age the battery. The most common and damaging result of AC ripple is battery heating which can lead to thermal runaway. AC ripple will decrease battery life and should be reduced as much as possible.

12.9 Ohmic Measurements

Impedance, resistance and conductance testing is collectively known in the industry as ohmic measurements. Each measurement is derived using a manufacturer-specific and proprietary algorithm and / or frequency. This means that one type of measurement cannot be converted or related easily to another.

"Reference" ohmic values are of dubious value because so many factors can affect the way the readings are made and displayed by the devices. Connector configuration and AC ripple as well as differences between readings of temperature and probe placement will prevent the ohmic devices from generating consistent and meaningful data. The meters work better with monoblocs and small capacity VRLA products and less well with large (>800-Ah) VRLA and flooded battery designs. Users should be particularly skeptical of data taken on series-parallel VRLA battery configurations as the feedback signal to the device may follow unforeseen paths that can overwhelm it.

It is best for users to establish their own baseline values for their battery as specifically configured. Do not rely on reference values.

If users wish to enhance normal maintenance and record-keeping with ohmic measurements, EXIDE recommends the trending of this data over time. Use a first set of readings taken 6 months after initial charge and installation as the baseline data. Subsequent measurements should be taken using the same device over the life of the battery. Because cell positioning within the string (connector configuration to a particular cell) can affect the reading, always compare each cell at baseline to itself in the new data. Standalone ohmic data is not sufficient to justify warranty cell replacement.
Responsible ohmic device manufacturers acknowledge that there is no direct relationship between percent ohmic change from baseline and battery capacity. A change from baseline of 25% or less is in the normal noise or variability range. Changes between 25% and 50% may call for additional scrutiny of the system. An IEEE compliant discharge test is usually warranted on systems exhibiting more than a 50% change from baseline. Consult an EXIDE representative for specific questions about ohmic data.

SECTION 13

13.0 Equalizing Charge

Under normal operating conditions an equalizing charge is not required. An equalizing charge is a special charge given a battery when non-uniformity in voltage has developed between cells. It is given to restore all cells to a fully charged condition. Use a charging voltage higher than the normal float voltage and for a specified number of hours, as determined by the voltage used.

Non-uniformity of cells may result from low float voltage due to improper adjustment of the charger or a panel voltmeter which reads an incorrect (higher) output voltage. Also, variations in cell temperatures greater than 5°F (2.78°C) in the series string at a given time, due to environmental conditions or module arrangement, can cause low cells.

13.1 Equalizing Frequency

An equalizing charge should be given when the following conditions exist:

A. The float voltage of any cell (as per Section 14.0) is less than 2.18 VPC.

B. A recharge of the battery is required in a minimum time period following an emergency discharge.

C. Individual cell(s) float is more than +/- 0.05 volts from average.

D. Accurate periodic records (See Section 15) of individual cell voltages show an increase in spread since the previous semi-annual readings.

An annual equalize charge is recommended to help ensure uniform cell performance.

13.2 Equalizing Charge Method

Constant voltage charging is the method for giving an equalizing charge. Determine the maximum voltage that may be applied to the system equipment. This voltage, divided by the number of cells connected in series, will establish the maximum volts per cell that may be used to perform the equalizing charge in the shortest period of time (not to exceed 2.35 VPC applicable at 77°F, 25°C). Refer to Table C for voltages and recommended time periods.

NOTE: Charge volts listed in Table C are for 77°F. For other temperatures a compensation factor of .003 V/°F (.0055 V/°C) per cell is recommended. The minimum voltage is 2.20 VPC. The maximum voltage is 2.35 VPC. Temperature correction does not apply outside of this range.

V corrected = V25°C - ((T actual-25°C) x (.0055 V/°C))or
V corrected = V77°F - ((T actual-77°F) x (.003 V/°F))

See Appendix A for standard values.

STEP 1

A. Set constant voltage charger to maximum setting without exceeding 2.35 VPC.
Example: For a target charge of 2.35 VPC on a 24-cell system, you would set the charger voltage to 56.4 volts.

B. Record time and current at regular intervals – every hour as a minimum.

C. Continue charging the battery until there is no further drop in charge current over 3 consecutive hours.

D. When the current has stabilized, proceed to step 2.

STEP 2

A. Continue the charge for the time listed in Table C depending on the charger voltage setting. The time is IN ADDITION to the time spent charging in Step 1.
Example, charge for 12 hours if the charger voltage is set to 2.35 VPC.

TABLE C

EQUALIZE CHARGE (77°F)

CELL VOLTS	TIME (HOURS)
2.30	24
2.35	12

B. Record cell voltages hourly during the last 3 hours of the charge time. If, after the charge time has completed, but the lowest cell voltage has continued to rise, you may extend the charge, monitoring cell voltages hourly, until the lowest cell voltage ceases to rise.

C. Proceed to Step 3.

STEP 3

The Equalize charge is now complete. Charger voltage can now be reduced to float voltage setting per Section 12.2. For a target float charge of 2.25 VPC on a 24-cell system, you would set the charger voltage to 54 volts.

SECTION 14

14.0 Pilot Cell

A pilot cell is selected in the series string to reflect the general condition of cells in the battery. The cell selected should be the lowest cell voltage in the series string following the initial charge. See Section 11.0 - Initial Charge. Reading and recording pilot cell voltage monthly serves as an indicator of battery condition between scheduled overall individual cell readings.

SECTION 15

15.0 Records

The following information must be recorded at installation, and annually for every year of operation after installation. These records must be maintained throughout the life of the battery and made available for review by EXIDE representatives for capacity or life related warranty claims. Failure to collect and store these maintenance data will void the warranty. Please review the warranty statement specific to the battery application for any additional requirements.

- Individual cell voltages
- Overall string voltage
- Ambient temperature immediately surrounding battery
- Battery temperature at several places throughout the string. Recommend 1 reading per battery stack. More data points are recommended for larger batteries and to check for temperature gradients. Readings on the tray, cell cover or negative terminal are good places to measure battery temperature. Take readings away from HVAC sources.
- Float current measured at stack to stack connections (optional)
- Ohmic measurements (optional). Baseline ohmic readings of individual cells should be taken 6 months from the date of initial charge.
- Retorque connectors as part of annual maintenance.

ONCE PER YEAR READINGS ARE THE ABSOLUTE MINIMUM REQUIRED TO PROTECT WARRANTY. More frequent readings are recommended, especially for critical sites. Good record-keeping will prevent minor issues from escalating into more serious problems over time. See Figure 25 for sample record-keeping form.

SECTION 16

16.0 Tap Connections

Tap connections should not be used on a battery. This can cause overcharging of the unused cells and undercharging of those cells supplying the load, thus reducing battery life.

SECTION 17

17.0 Temporary Non-Use

An installed battery that is expected to stand idle longer than the maximum storage interval (see Sec. 4.2), should be treated as stated below. The maximum storage interval is 6 months if stored at 77°F.

Give the battery an equalizing charge as per Section 13. Following the equalizing charge, open connections at the battery terminals to remove charger and load from the battery.

Repeat the above after every 6 months (77°F) or at the required storage interval. See Section 4.2 for adjustments to storage intervals when the storage temperature exceeds 77°F.

To return the battery to normal service, re-connect the battery to the charger and the load, give an equalizing charge and return the battery to float operation.

SECTION 18

18.0 Unit Cleaning

Periodically clean cell covers with a dry 2" paintbrush to remove accumulated dust. If any cell parts appear to be damp with electrolyte or show signs of corrosion, contact your local EXIDE representative.

CAUTION!

Do not clean plastic parts with solvents, detergents, oils, mineral spirit or spray type cleaners as these may cause crazing or cracking of the plastic materials.

SECTION 19

19.0 Connections

Battery terminals and intercell connections should be corrosion free and tight for trouble-free operation. Periodically these connections should be inspected.

CAUTION!

DO NOT WORK ON CONNECTIONS WITH BATTERY CONNECTED TO CHARGER OR LOAD.

If corrosion is present, disconnect the connector from the terminal.

Gently clean the affected area using a suede brush or Scotch Brite scouring pad. Apply a thin coating of NO-OX-ID "A" grease to the cleaned contact surfaces, reinstall connectors and retorque connections to 11.3 Newton-meters (100 inch pounds).

ALL TERMINAL AND INTERCELL CONNECTIONS SHOULD BE RETORQUED AT LEAST ONCE EVERY YEAR TO 11.3 NEWTON-METERS (100 INCH POUNDS).

NOTE: Design and/or specifications subject to change without notice. If questions arise, contact your local sales representative for clarification.

SECTION 20

20.0 Capacity Testing

When a capacity discharge test is desired, it is recommended that it be performed in accordance with IEEE-1188*, latest revision.

An equalizing charge, as described in Section 13.2, must be completed within 7 days prior to the capacity test. The batteries must be returned to float charging immediately after the equalize charge completes. Allow the batteries to float at least 72 hours prior to capacity discharge.

After the capacity discharge has completed, the batteries can be recharged in the shortest amount of time by following the equalize charge procedure described in Section 13.2.

*IEEE-1188: Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications.

DATE: _____

ABSOLYTE BATTERY MAINTENANCE REPORT

COMPANY: _____ SERIAL NUMBER: _____ PAGE 1 OF _____

ADDRESS: _____ BATTERY LOCATION / NUMBER: _____

No. of CELLS: _____ TYPE: _____ MANUF. DATE: _____ INSTALL DATE: _____

SYSTEM VOLTAGE: _____ TEMPERATURE: _____ CHARGER VOLTAGE: _____ CHARGER CURRENT: _____

Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp	Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp	Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp	Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp
1					31					61					91				
2					32					62					92				
3					33					63					93				
4					34					64					94				
5					35					65					95				
6					36					66					96				
7					37					67					97				
8					38					68					98				
9					39					69					99				
10					40					70					100				
11					41					71					101				
12					42					72					102				
13					43					73					103				
14					44					74					104				
15					45					75					105				
16					46					76					106				
17					47					77					107				
18					48					78					108				
19					49					79					109				
20					50					80					110				
21					51					81					111				
22					52					82					112				
23					53					83					113				
24					54					84					114				
25					55					85					115				
26					56					86					116				
27					57					87					117				
28					58					88					118				
29					59					89					119				
30					60					90					120				

ADDITIONAL COMMENTS: _____

Figure 25.1

DATE: _____

ABSOLYTE BATTERY MAINTENANCE REPORT

COMPANY: _____ SERIAL NUMBER: _____ PAGE 1 OF _____

ADDRESS: _____ BATTERY LOCATION / NUMBER: _____

No. of CELLS: _____ TYPE: _____ MANUF. DATE: _____ INSTALL DATE: _____

SYSTEM VOLTAGE: _____ TEMPERATURE: _____ CHARGER VOLTAGE: _____ CHARGER CURRENT: _____

Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp	Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp	Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp	Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp
1					31					61					91				
2					32					62					92				
3					33					63					93				
4					34					64					94				
5					35					65					95				
6					36					66					96				
7					37					67					97				
8					38					68					98				
9					39					69					99				
10					40					70					100				
11					41					71					101				
12					42					72					102				
13					43					73					103				
14					44					74					104				
15					45					75					105				
16					46					76					106				
17					47					77					107				
18					48					78					108				
19					49					79					109				
20					50					80					110				
21					51					81					111				
22					52					82					112				
23					53					83					113				
24					54					84					114				
25					55					85					115				
26					56					86					116				
27					57					87					117				
28					58					88					118				
29					59					89					119				
30					60					90					120				

ADDITIONAL COMMENTS: _____

Figure 25.2

APPENDIX A

Temperature Corrected Float Voltages

Expressed in Volts per Cell

Battery Temperature (°C)	Float Voltage at 25°C				
	2.23	**2.24**	**2.25**	**2.26**	**2.27**
3	2.35				
4	2.35	2.35			
5	2.34	2.35			
6	2.34	2.35			
7	2.33	2.34	**2.35**		
8	2.33	2.34	**2.35**		
9	2.32	2.33	**2.34**	2.35	
10	2.32	2.33	**2.34**	2.35	
11	2.31	2.32	**2.33**	2.34	2.35
12	2.31	2.32	**2.33**	2.34	2.35
13	2.30	2.31	**2.32**	2.33	2.34
14	2.30	2.31	**2.32**	2.33	2.34
15	2.29	2.30	**2.31**	2.32	2.33
16	2.28	2.29	**2.30**	2.31	2.32
17	2.28	2.29	**2.30**	2.31	2.32
18	2.27	2.28	**2.29**	2.30	2.31
19	2.27	2.28	**2.29**	2.30	2.31
20	2.26	2.27	**2.28**	2.29	2.30
21	2.26	2.27	**2.28**	2.29	2.30
22	2.25	2.26	**2.27**	2.28	2.29
23	2.25	2.26	**2.27**	2.28	2.29
24	2.24	2.25	**2.26**	2.27	2.28
25	2.23	2.24	**2.25**	2.26	2.27
26	2.23	2.24	**2.25**	2.26	2.27
27	2.22	2.23	**2.24**	2.25	2.26
28	2.22	2.23	**2.24**	2.25	2.26
29	2.21	2.22	**2.23**	2.24	2.25
30	2.21	2.22	**2.23**	2.24	2.25
31	2.20	2.21	**2.22**	2.23	2.24
32	2.20	2.21	**2.22**	2.23	2.24
33		2.20	**2.21**	2.22	2.23
34		2.20	**2.21**	2.22	2.23
35			**2.20**	2.21	2.22
36			**2.20**	2.20	2.21
37				2.20	2.21
38					2.20
39					2.20

Battery Temperature (°F)	Float Voltage at 77°F				
	2.23	**2.24**	**2.25**	**2.26**	**2.27**
55	2.30	2.31	**2.32**	2.33	2.34
56	2.29	2.30	**2.31**	2.32	2.33
57	2.29	2.30	**2.31**	2.32	2.33
58	2.29	2.30	**2.31**	2.32	2.33
59	2.28	2.29	**2.30**	2.31	2.32
60	2.28	2.29	**2.30**	2.31	2.32
61	2.28	2.29	**2.30**	2.31	2.32
62	2.28	2.29	**2.30**	2.31	2.32
63	2.27	2.28	**2.29**	2.30	2.31
64	2.27	2.28	**2.29**	2.30	2.31
65	2.27	2.28	**2.29**	2.30	2.31
66	2.26	2.27	**2.28**	2.29	2.30
67	2.26	2.27	**2.28**	2.29	2.30
68	2.26	2.27	**2.28**	2.29	2.30
69	2.25	2.26	**2.27**	2.28	2.29
70	2.25	2.26	**2.27**	2.28	2.29
71	2.25	2.26	**2.27**	2.28	2.29
72	2.25	2.26	**2.27**	2.28	2.29
73	2.24	2.25	**2.26**	2.27	2.28
74	2.24	2.25	**2.26**	2.27	2.28
75	2.24	2.25	**2.26**	2.27	2.28
76	2.23	2.24	**2.25**	2.26	2.27
77	2.23	2.24	**2.25**	2.26	2.27
78	2.23	2.24	**2.25**	2.26	2.27
79	2.22	2.23	**2.24**	2.25	2.26
80	2.22	2.23	**2.24**	2.25	2.26
81	2.22	2.23	**2.24**	2.25	2.26
82	2.22	2.23	**2.24**	2.25	2.26
83	2.21	2.22	**2.23**	2.24	2.25
84	2.21	2.22	**2.23**	2.24	2.25
85	2.21	2.22	**2.23**	2.24	2.25
86	2.20	2.21	**2.22**	2.23	2.24
87	2.20	2.21	**2.22**	2.23	2.24
88		2.21	**2.22**	2.23	2.24
89		2.20	**2.21**	2.22	2.23
90		2.20	**2.21**	2.22	2.23
91			**2.21**	2.22	2.23
92			**2.21**	2.22	2.23
93			**2.20**	2.21	2.22
94			**2.20**	2.21	2.22
95				2.21	2.22

APPENDIX B

MAXIMUM STORAGE INTERVAL BETWEEN FRESHENING CHARGES VERSUS AVERAGE STORAGE TEMPERATURE

Average Ambient Storage Temperature (°C)	Maximum Storage Interval	
	Months	Days
25	6	0
26	5	18
27	5	7
28	4	26
29	4	16
30	4	7
31	3	29
32	3	21
33	3	13
34	3	7
35	3	0
36	2	24
37	2	18
38	2	13
39	2	8
40	2	4
41	1	29
42	1	25
43	1	22
44	1	18
45	1	15

Average Ambient Storage Temperature (°F)	Maximum Storage Interval	
	Months	Days
77	6	0
78	5	23
79	5	17
80	5	10
81	5	4
82	4	29
83	4	23
84	4	18
85	4	12
86	4	7
87	4	3
88	3	28
89	3	23
90	3	19
91	3	15
92	3	11
93	3	7
94	3	4
95	3	0
96	2	27
97	2	23
98	2	20
99	2	17
100	2	14
101	2	11
102	2	9
103	2	6
104	2	4
105	2	1
106	1	29
107	1	27
108	1	25
109	1	23
110	1	21
111	1	19
112	1	17
113	1	15

APPENDIX C

BONDING & GROUNDING OF BATTERY RACK

INTRODUCTION

1. To insure personnel safety, and equipment protection, operation, and reliability, the battery rack should be connected to the Common Bonding Network (CBN).

2. Electrical continuity between modules is provided through the use of serrated hardware. If continuity between the horizontal supports (I-beams) and the bottom module is desired, the use of a grounding kit (EXIDE P/N: K17ABSGPGRND) is required. This kit is available through your local EXIDE representative.

GROUNDING KIT INSTALLATION

1. Each kit consists of the following components:
   - (2) #6 AWG, 12 in. 90°C cables
   - (4) "C" shaped beam clamps
   - (4) 1/4-20 x 0.75 in. bolts
   - (4) 1/4-20 x 1.00 in. bolts

2. Using (1) 1/4-20 x 1.00 in. bolt per beam clamp, connect (1) beam clamp to the I-beam flange and (1) beam clamp to the back flange of the module (see Figure 1). Be sure to securely tighten the bolts such that the paint is penetrated (see Figure 2).

3. Attach each end of cable assembly to a beam clamp using (1) 1/4-20 x 0.75 in. bolt per end (see Figure 3). Tighten hardware securely.

4. Repeat Steps 2 and 3 for the second horizontal support (I-beam).

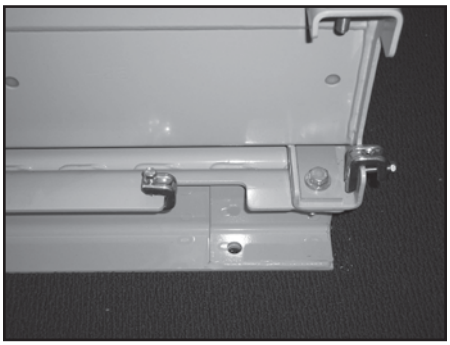


Figure 1: Beam Clamp Installation

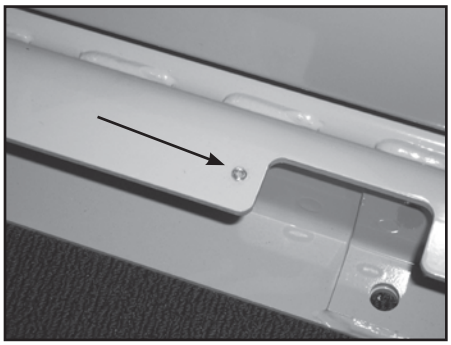


Figure 2: Adequate Paint Penetration

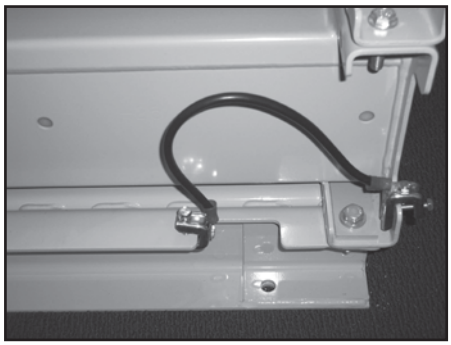


Figure 3: Cable Assembly Installation

CONNECTING TO THE CBN

1. The recommended location for attaching the frame ground is the back "C" channel on the upper module of the stack (see Figure 4).

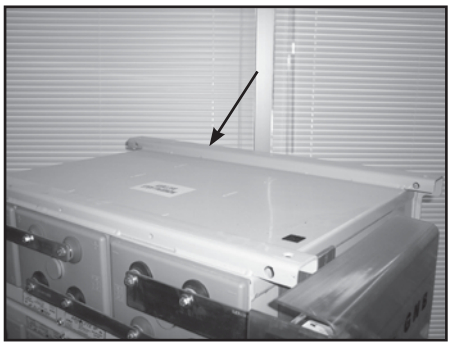


Figure 4: Recommended Frame Ground Location

2. Once the location is determined, it will be necessary to drill (2) holes for the frame ground conductor/lug (installer supplied). Note, hole size and spacing will be dependent on the lug.

3. Using a grinder, etc., remove the paint from around the holes drilled in Step 2. Apply a thin film of NO-OXID grease to the bare metal and attach the frame ground conductor/lug.

APPENDIX D

Absolyte GP Maximum Module Stack Heights
Horizontal Arrangement

		1997 UBC Ground Level Zone			
Series	**Height**	**1**	**2B**	**3**	**4**
100G	10 high	100G33	100G33	100G31	100G17
	9 high	100G33	100G33	100G33	100G23
	8 high	100G33	100G33	100G33	100G33
90G	10 high	90G15	90G15	90G15	90G09
	9 high	90G15	90G15	90G15	90G11
	8 high	90G15	90G15	90G15	90G15
50G	10 high	50G09	50G09	50G09	50G09
	9 high	50G11	50G11	50G11	50G11
	8 high	50G15	50G15	50G15	50G15

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MidNite Solar Classic
Owner's Manual 1/7/13

Standard Classic *Classic Lite*

This Manual covers models Classic 150, 200, 250 & 250KS as well as the Classic 150, 200, 250 & 250KS LITE

Este manual también está disponible en Español. La versión en Español puede encontrarse en nuestra pagina web en la ficha Documentos y haga clic en Manuales.

The MidNite Solar Classic charge controller conforms to ***UL 1741, Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, Second Edition, May 7, 1999 with revisions through January 28, 2010 and***
CAN/CSA C22.2 No. 107.1: 2001/09/01 Ed: 3 (R2006)

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Email: customerservice@midnitesolar.com
Web: www.midnitesolar.com

Contents

Absorb – Constant voltage charge stage to fill the batteries. The controller is regulating so maximum power will not be seen at this time. The Absorb timer is also counting down to the switch to Float.

A-EQ-R – This will reload the Auto Equalize counters, basically it will start the counters from day 1.

AF – Arc Fault, See page 46 for more info on arc fault protection.

Arc Adjust – This menu is where you adjust the Arc Fault sensitivity. For info on Arc Fault see page 46.

A-RST – Auto reset of the Classic controller, The Classic will reboot around Midnight every night when this is enabled. This is useful for very remote sites where a loss of internet capability for example would be a hard ship.

Aux – Auxiliary relays. The Classic has 2 relays: Aux 1 can be configured as a 12 volt signal or a dry relay, Aux 2 can be used as a PWM signal output. Refer to page 36 for more Aux info.

BLK – Bulk MPPT Mode. By using the up arrow in Tweaks under BLK you can force the Classic into Bulk mode.

Bulk MPPT - Maximum current charge stage, the Classic is trying to bring the batteries to the Absorb voltage set point. We are basically putting all available power into the batteries.

Comm – This Menu allows adjustment of things like Mod Bus port, USB Mode and MNGP address.

DvrtCnt – When enabled, allows the charge stage timers to continue to run when the diversion modes are holding the battery voltage just below the actual set point.

Equalize - Constant voltage charge stage to equalize the batteries. The controller is regulating so maximum power will not be seen at this time. The Equalize timer is also counting down to the switch to Float.

EQ MPPT - Maximum current charge stage, the Classic is trying to bring the batteries to the Equalize voltage set point. We are basically putting all available power into the batteries.

Float – Constant voltage charge stage with a lower voltage than the Absorb charge point. The controller is regulating so maximum power will not be seen at this time.

Float MPPT – Maximum current charge stage, the Classic is trying to bring the batteries to the Float voltage set point. We are basically putting all available power into the batteries.

FLT – Float mode. By using the up arrow in Tweaks under FLT you can force the Classic into Float mode.

GF – Ground Fault, See page 22 for more info on ground fault protection.

Got Comm – Indicates a lack of communication between the display and the Classic. Consult Troubleshooting for information page 71.

Insomnia – This when enabled, will keep the Classic from going to Resting. This is intended for hydro mode only where you may need time to open water valves and do not want to wait for the Classic to wake up.

LED-MODE – This selection lets you pick the function of the 6 visible LED's on a standard Classic.

LMX – LoMax, This enables the Classic to track the input voltage all the way down to Battery voltage. When disabled the Classic will stop tracking the input around 5 volts above the battery voltage. When the input voltage is within a couple volts of the battery voltage the inductors can "Sing" this is usually not very loud and will do no harm.

Local App – Monitoring software included with the Classic for monitoring over the Local Network or Internet.

MNGP – Midnite Graphical interface Panel. This is the graphical display included with the standard Classic controller.

MNLP – MidNite LED interface Panel. This is the LED display that comes standard with the Classic Lite.

Mode – This menu lets you turn the charging ability of the controller On / Off as well as lets you select the DC input source. See page 31 for info on the Mode menu.

Mod Bus – a standard protocol used for communications. We have published our protocol to allow users to interface with the Classic. See page **Error! Bookmark not defined.** for our Mod Bus protocol.

My MidNite – Web based monitoring for the Classic. (Not available yet)

NiteLog – When enabled allows the Classic to log data in the evening when the Classic is Resting.

PV Shading – This indicates the Maximum power point voltage is less than half the open circuit voltage.

Pwr Save – Allows you to adjust the time the Backlight stays on.

Resting – The Classic is not charging the battery due to low light. For reasons Resting will appear please see page 31.

Shade – When enabled the Classic will show PV Shading on the display when the Maximum power point voltage is less than half the open circuit voltage.

T-Comp – Temperature compensation using a temperature sensor to measure the ambient temperature of the battery bank and will adjust the voltage set points up or down accordingly to ensure a full battery. There are 3 parameters to set Minimum and Maximum adjusted voltage as well as volts per degree C per Cell. Typically this is -.05 mV but please consult your battery manufacturer. See page 16 for Temperature compensation info.

Tweaks – This menu has all the advanced adjustments for the Classic. For example: Voltage off set adjustments etc.

VBatt – Battery voltage, measured at the battery terminals of the Classic.

VOC – Open Circuit Voltage, unloaded voltage measurement.

Vpv – Input voltage, measured at the input terminals of the Classic.

Web Access – When enabled allows the Classic to send data over the internet to My MidNite's Server for you to view when wanted.

Scope

This Manual provides safety guidelines and installation information for the Classic charge controller. It does not provide brand specific information about photovoltaic panels, batteries etc. Contact the manufacturer of other components in the system for relevant technical data.

Introduction

The MidNite Classic charge controller is unique in its ability to be used for a great variety of DC input sources. The Classic is designed to regulate DC input from PV, and Approved Hydro and Wind turbines for other DC sources please contact MidNite Solar tech support.. The Classic 150, 200 and 250 are designed to work with 12, 24, 36, 48, 60 and 72 volt battery banks.
The Classic250KS is designed to charge up to a 120V nominal battery bank.
The Classic can be installed stand alone or as a multi-unit networked installation.

Standard features of the Classic charge controller include:
*3 input operating voltage ranges 150, 200 and 250 VDC
*Multiple DC input options (example Solar, Wind or Hydro)
*Wizard driven setup interface including voice and help screens
*Graphical display
*Previous 180 days of operational data logged
*Internet ready

This Manual covers ***Classic 150, Classic 200 Classic 250 and the Classic 250KS***. It covers the installation, wiring and use of the Classic charge controller.

WARNING Warnings signs identify conditions or practices that could result in personal injury or loss of life.

CAUTION Cautions identify conditions or practices that could result in damage to the unit or other equipment.

MIDNITE SOLAR CHARGE CONTROLLER INSTALLATION GUIDELINES AND SAFETY INSTRUCTIONS

This product is intended to be installed as part of a permanently grounded electrical system as shown in the system configuration sections. The following important restrictions apply *unless superseded by local or national codes*:

•The System's DC Negative conductor must not be bonded to earth ground. The Classic does this with its internal Ground Fault Protection circuitry. The battery negative and ground are not bonded together directly but are connected together by the Classic's internal GFP device. All negative conductor connections must be kept separate from the grounding conductor connections. The equipment ground terminal inside the Classic must be connected to Earth Ground for the internal DC-GFP to work.

Continue

• With the exception of certain telecom applications, the Charge Controller should *never* be positive grounded.

• The Charge Controller equipment ground is marked with this symbol: 
• If damaged or malfunctioning, the Charge Controller should only be disassembled and repaired by a qualified service center. Please contact your renewable energy dealer/installer for assistance. Incorrect reassembly risks malfunction, electric shock or fire.
• The Charge Controller is designed for indoor installation or installation inside a weatherproof enclosure. It must not be exposed to rain and should be installed out of direct sunlight.

For routine, user-approved maintenance:

• Turn off all circuit breakers, including those to the solar modules, batteries and related electrical connections before performing any maintenance.

Standards and Requirements

All installations must comply with national and local electrical codes; professional installation is recommended. The NEC in the USA requires a DC ground fault interrupter for all residential PV installations. NEC2011 requires an ARC FAULT detector on all charge controllers and inverters operating above 80VDC. Both of these devices are built into the Classic.

DC and Battery-Related Installation Requirements:

- ❖ All DC cables must meet local and national codes.
- ❖ Shut off all DC breakers before connecting any wiring.
- ❖ Torque all the Charge Controller's wire lugs and ground terminals to the specs found on page 19.
- ❖ Copper wiring must be rated at 75° C or higher.
- ❖ Keep cables close together (e.g., using a tie-wrap) as much as possible to reduce inductance.
- ❖ Ensure both cables pass through the same knockout and conduit to allow the inductive currents to cancel.
- ❖ DC battery over-current protection must be used as part of the installation on the input and output.
- ❖ Breakers between the battery and the Classic must meet UL489 standards.
- ❖ Breakers between the DC source and the Classic must meet UL1077 or UL489 standards.

Design the battery enclosure to prevent accumulation of hydrogen gas at the top of the enclosure. Vent the battery compartment from the highest point to the outside. A sloped lid can also be used to direct the flow of hydrogen to the vent opening. Sealed (AGM, Gel etc) batteries do not normally require ventilation. Consult your battery manufacturer for details.

WARNING: PERSONAL PRECAUTIONS DURING INSTALLATION

WARNING BATTERIES PRESENT RISK OF ELECTRICAL SHOCK, BURN FROM HIGH SHORT CIRCUIT CURRENT, FIRE OR EXPLOSION FROM VENTED GASES. FOLLOW PROPER PRECAUTIONS.

- ❖ Someone should be within range of your voice to come to your aid if needed.
- ❖ Keep plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes.

- Wear complete eye protection. Avoid touching eyes while working near batteries. Wash your hands with soap and warm water when done.
- If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters an eye, flood the eye with running cool water at once for at least 15 minutes and get medical attention immediately following.
- Baking soda neutralizes lead acid battery electrolyte. Keep a supply on hand in the area of the batteries.
- NEVER smoke or allow a spark or flame in vicinity of a battery or generator.
- Be cautious to reduce the risk of dropping a metal tool onto batteries. It could short the batteries or other electrical parts that can result in fire or explosion.
- Never wear metal items such as rings, bracelets, necklaces, and watches when working with a battery or other electrical circuits. A battery can produce a short circuit current high enough to weld a ring or the like to metal, causing severe burns.

Classic Power Curves

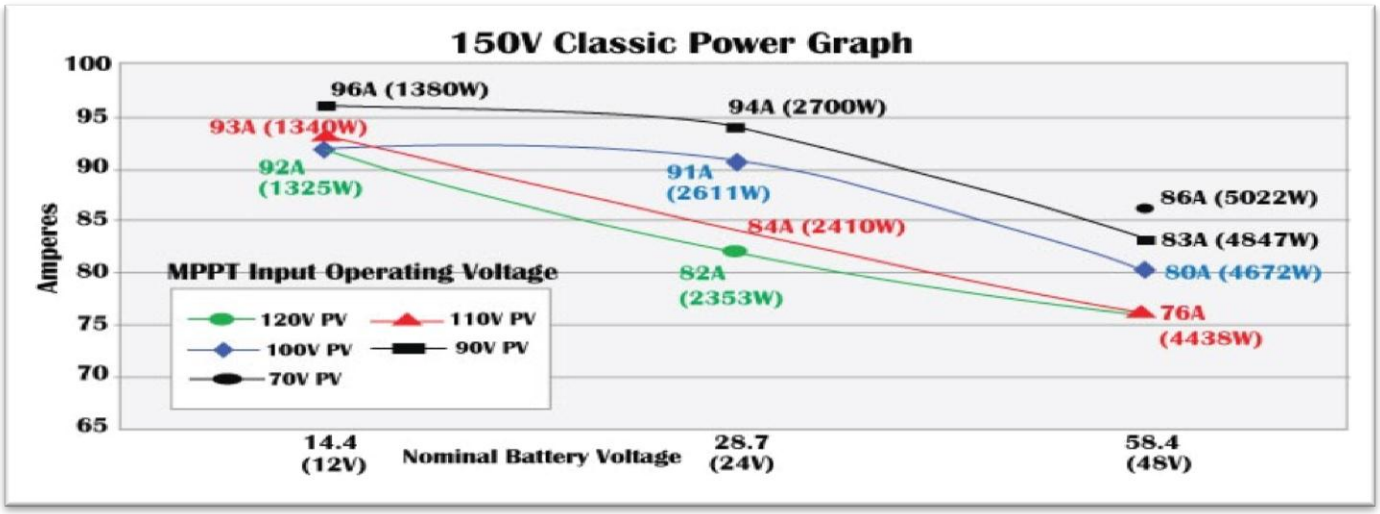


Table 1

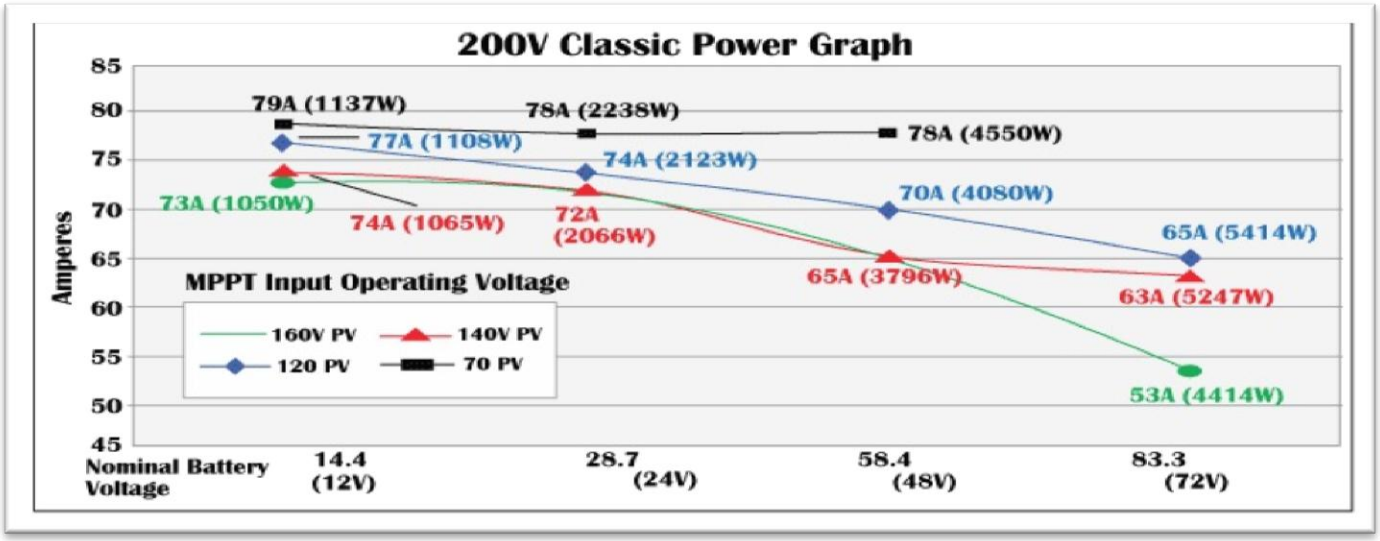


Table 2

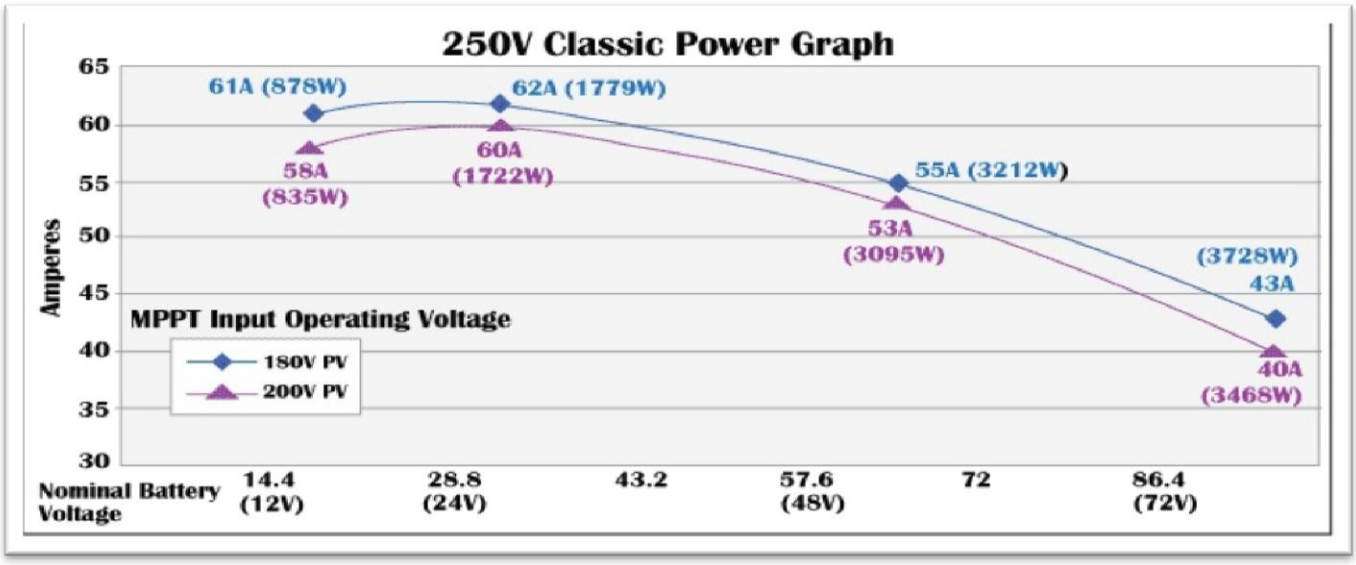


Table 3

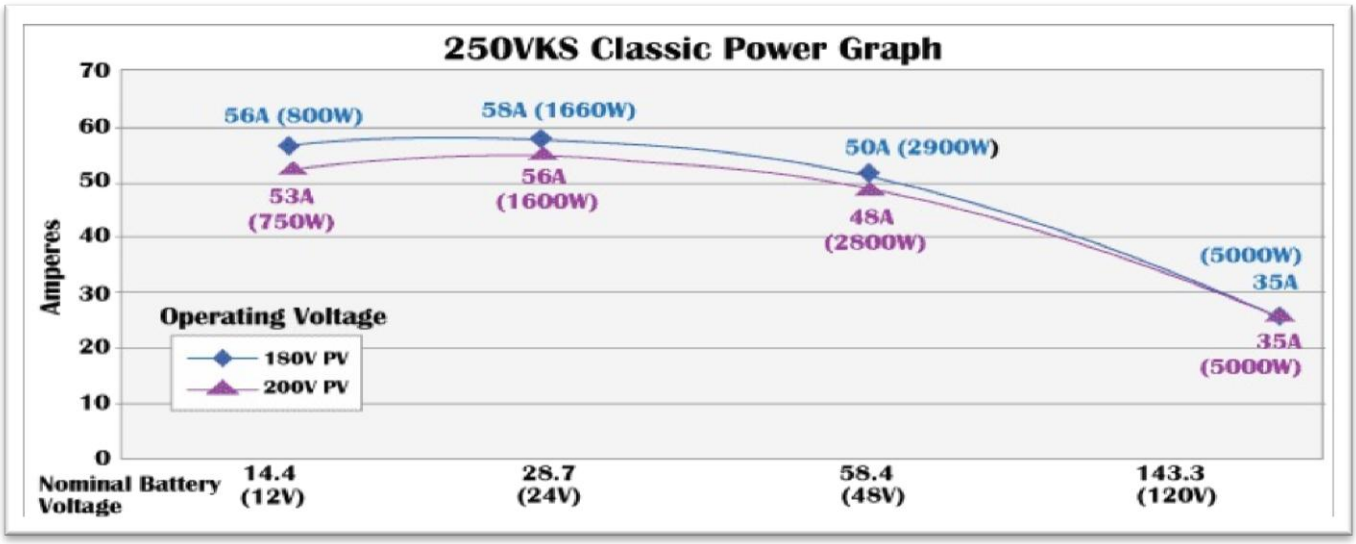


Table 4

The graphs above represent the max power output for a given input for each Classic. Using and understanding these power graphs will help maximize Classic's output power and aid in selecting wire and breaker/disconnects. The built in set up wizard also helps select breakers and wire sizes. Notice that lower battery voltages and lower PV input voltages result in higher continuous output power. The PV voltages listed are for reference and are not intended to be the only PV voltages supported. The battery voltages listed show the most used battery bank configurations. Other voltages are also supported. The Classic battery voltage parameters are fully user adjustable.

For example: if you are using a Classic 250 and 48v battery bank, the maximum continuous output power based on 25 degree C ambient is 55 amps when using a PV array that yields a Maximum Power Voltage of 180 volts. The same set up using a bit higher voltage modules that result in a 200V Maximum Power voltage will result in only 53 amps. Although 55 to 53 amps is not a significant change, it does give you the idea that all things being equal, lower voltages are a bit more efficient.

Unpacking the Classic

When you receive your Classic you will want to unpack it and make sure everything is there and in good shape. Refer to Figure 1.1. Included in the Classic package should be:

*Classic charge controller
*Battery temperature sensor
*Knock out covers 4 screened
*User's manual DVD, printed installation instructions
*USB cable for upgrading Firmware
**Snap on upper vent cover
**Knock out covers 4 solid

**Note. These items are optional and do not ship as standard equipment. Email customerservice@midnitesolar.com for more information or if anything is missing or damaged.

Figure 1

Removing and installing the front cover on the Classic

Removing the front art deco cover is required to gain access to the wiring compartment.
Be aware if this is not the first removal of this cover there is a cable connecting the cover to the electronics. Do not pull hard or fast as damage could occur.

To remove the front cover of the Classic in preparation for installation, remove the 4 Phillips head screws with a #2 Phillips screwdriver. Lift the front half of the Classic casting off. You will need to unplug the display cable. It works the same as any phone cable.

To re-install the front cover of the Classic you will need to plug in the display cable and carefully route it around the components on the circuit board as you set the cover in place. See Figure 1.2 Do not force the cover if it does not seat into place easily stop and look for any cables or wires that may be interfering. With the cover seated in place install the four Phillips screws with a #2 Phillips screwdriver.

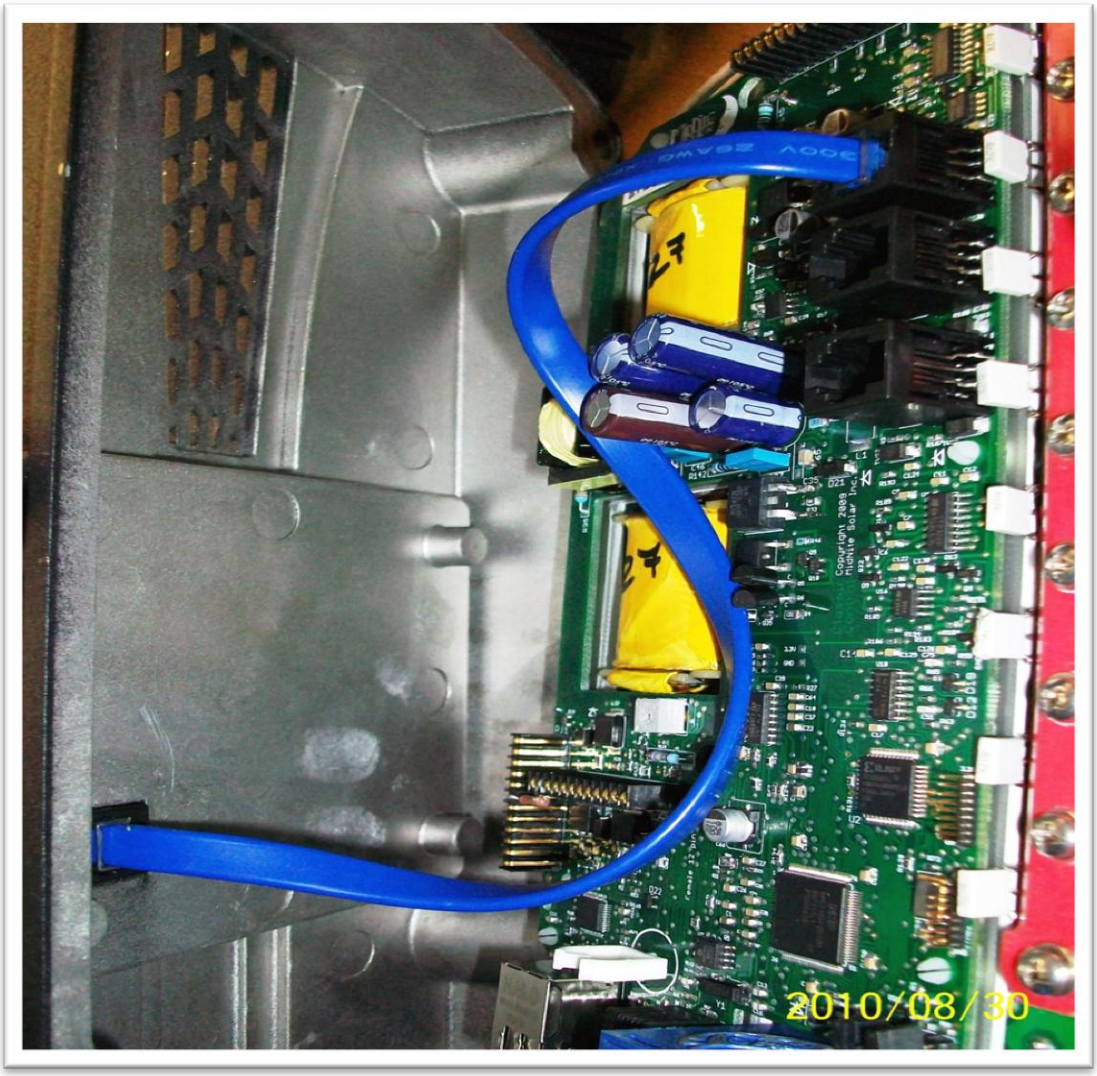


Figure 2

Mounting the Classic

The following section covers typical mounting arrangements. If you require additional details that are not covered here please contact our technical support team. The Classic is designed to be directly mounted onto the MidNite Solar E-Panel. The Classic can also accommodate other installation methods as well. Mount in an upright position out of direct sunlight when possible. For your convenience the Classic has four one inch knock outs that are pre cast. The Classic has mounting locations and conduit locations are similar to other brands of charge controllers to facilitate ease of upgrading older technologies.

Mounting the Classic directly to the E Panel:
*Remove the front cover of the Classic.
*Install the mounting bracket on the E Panel and start the upper mounting screw into the bracket leaving it about half way out so you can hang the Classic on this screw.
*Install the 1 inch close nipple into the E Panel as shown in the E-Panel directions. The 1" close nipple, 3 locknuts and 2 plastic bushings are included with each E-Panel. One locknut acts as a spacer.
*Carefully hang the Classic on the screw in the bracket and slide it over the close nipple see figure 1.3.
*Install the lock nut and bushing on the close nipple and tighten the screw in the mounting bracket.
*Don't install the front cover until you complete the wiring of the Classic.

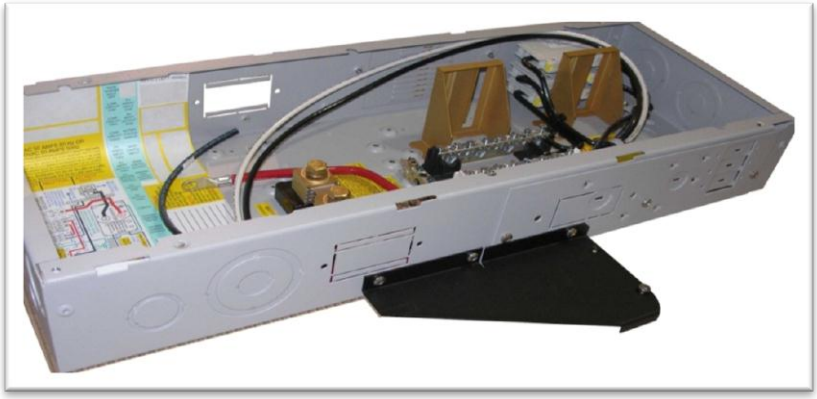


Figure 3 A Charge controller bracket mounted to the E-Panel. The bracket comes with every E-Panel

Figure 3

Classic Mounted to side of E-Panel

Figure 4

Nipple, locknuts and bushings that come with every E-Panel

Figure 5

Classic mounted to the side of a MidNite Solar E-Panel

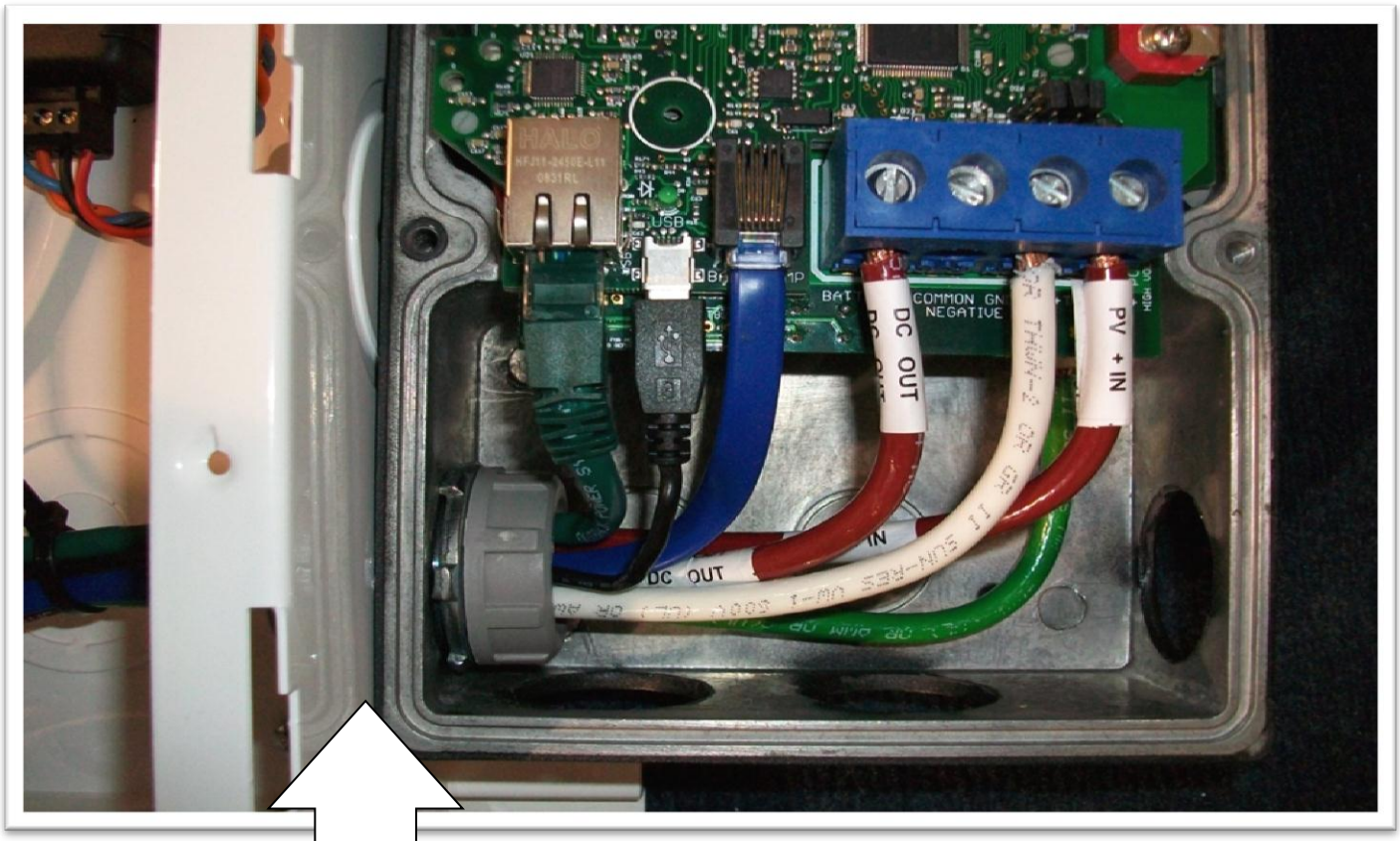


Figure 6

Install locknut here to act as a spacer.

Alternative Mounting

To mount the Classic to a plywood surface use 1 1/2" wood screws in the top key hole slot hole and the holes in the wiring compartment. Taking care to make sure the Classic is Plumb and Level.

Dimensions

See page 73 for more details.

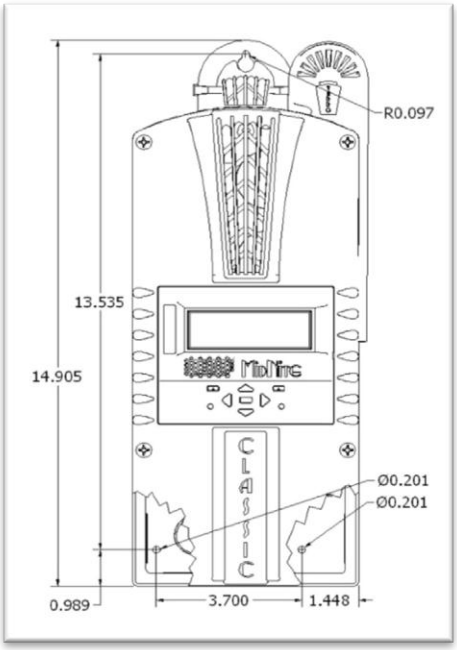


Figure 7

Sealed or Vented

The Classic has the ability to be sealed for protection from salt air or dust. It comes from the factory Vented. If you live in a dusty or salt air environment you may wish to seal the Classic. Sealing the Classic does not make the unit water resistant. To seal the Classic install the solid plastic knock out covers into any unused knock outs and snap the upper vent cover onto the Classic as seen in the photo below. Note that the Classic will be slightly de-rated (puts out less power) by sealing it. Refer to the specifications page of the owner's manual for the ratings in the sealed mode. To obtain the parts necessary to seal the Classic please contact our Technical Support Team. Refer to Figure and 1.5

Figure 8

Figure 9

Battery Temperature Compensation

The Classic comes with a battery temperature sensor (BTS). This sensor raises or lowers charge voltage based on temperature. Connect BTS to the BATT TEMP jack. *(Refer to* Battery Temperature Sensor Installation *19)* Battery temperature menu appears as **T-Comp** in the BATTERY MENU. In this menu you can change the voltage compensation as needed. If the BTS is disconnected or shorted the Classic will automatically use the default charge voltages non-compensated.

"Follow-ME" Charging coordination

Follow-Me will allow the Classics to share charge stages as well as Battery temperature info and Ground fault coordination. Follow-Me also allows you to program a single Classic for Equalize charging and it will instruct all the others to Equalize as well. You do need to set the Equalize parameters in each classic. For the Battery Temp sensor you will need one BTS only and it can be on any of the Classics.

The Follow Me function basically is just what it is called. The Classic will simply ask the Classic to its right "What do I do now" and this propagates around the loop continually. Whoever goes to Float first for instance will simply tell everyone else it is time to go to float.

To enable Follow Me you need to wire the classics network cables as shown below. You also need to enable Follow-ME. To do this, go to the Tweaks Menu. To do this press the "Main Menu" button repeatedly until "Charge" is highlighted. Scroll to the Right until "Tweaks" is highlighted and press "Enter". Now press the right soft key (Upper right button) 4 times until you see the screen with "Follow-ME" and "BTSNET" on it. Here you need to highlight Follow-ME and turn it on using the up arrow. You will also need to highlight BTSNET and turn it on if you want to share battery temperature data. After enabling these press Enter to save this data.

Ground Fault sharing.

To share Ground fault you need to install the GFP Jumper on one classic only. You then need to make sure Ground Fault is Enabled in the tweaks menu for any of the networked Classics you want to shut down on detection of ground fault. For example say you have 3 solar Classics and one Wind Classic and you do not want the wind Classic to shut down for GFP make sure in the tweaks menu of that Classic GFP is Disabled.

Naming the Classic

The included Local Application software allows you to issue a name to the Classic with upper and lower case letters, as well as numbers. This name can be up to 8 characters. This name will show up on the Display of the Classic instead of the word CLASSIC. It will be shown in all upper case on the Classics display. The Naming process can be helpful for networked Classics that use one MNGP (Display) to view multiple Classics.

Addressing the Classic's

You can assign unique addresses to each networked Classic. This is not necessary for Follow Me to work but it is necessary if you want to view multiple Classics from a single MNGP. To address a Classic simply use the MNGP that is plugged into that Classic, or plug the MNGP into that classic and hold the Left arrow button down and tap the up or down button. The normal default address is 10 so going up will take you to 11 and down to 9. When you get to the unused address you want for that Classic hold the left and right arrows for a second until Data sent and saved shows up. Now this Classic has been re addressed to the new address. Do this for all the Classics or Classic lites on the network.

To view other Classics on the network use the same button strokes. Hold the left arrow down and tap the up or down arrow depending on which number you are looking for. We suggest going from 10 up for clarity. So if you had 4 Classics they would be 10,11,12 and 13. You would scroll up from the normal position to find the other 3.

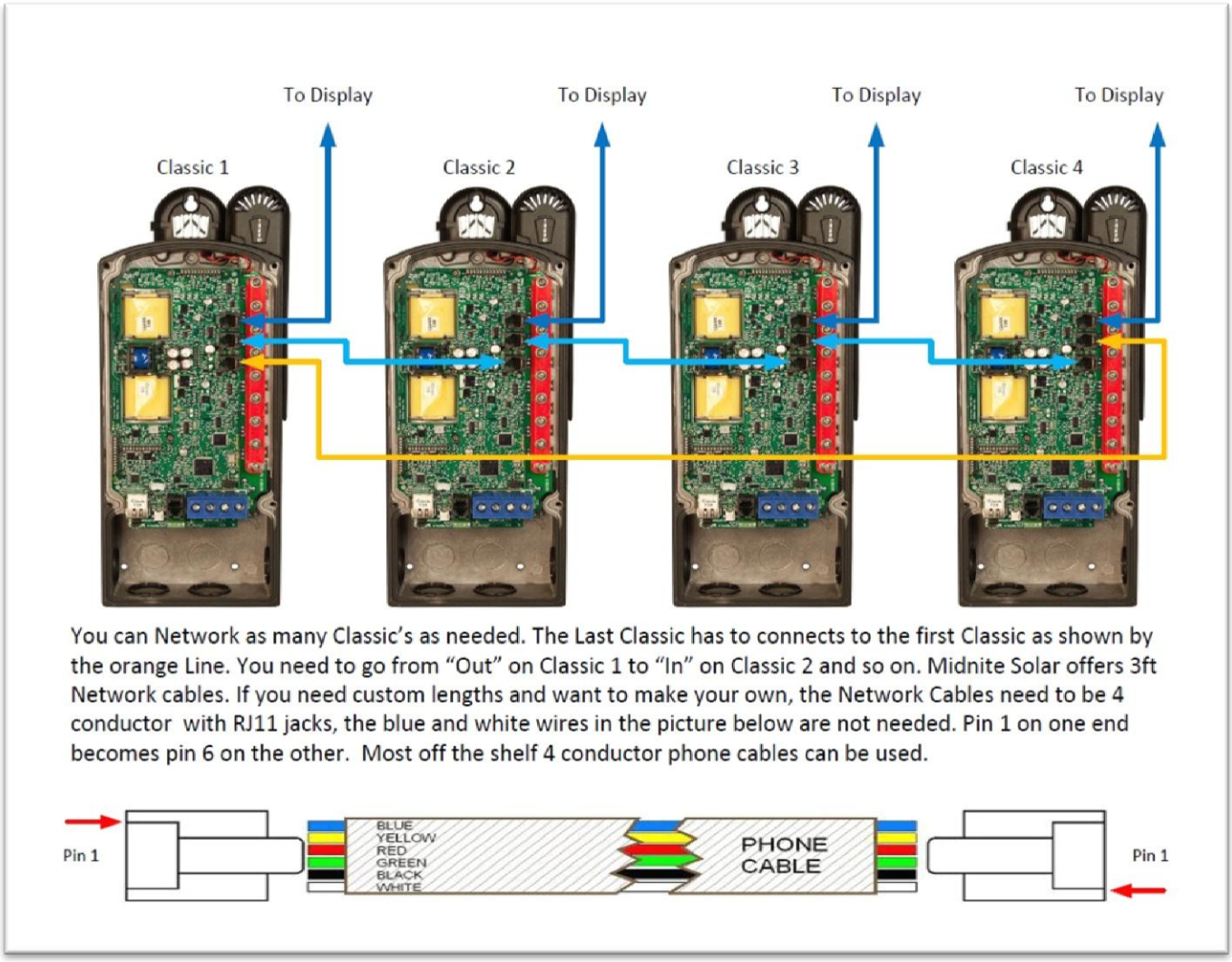


Figure 10 Follow-Me diagram

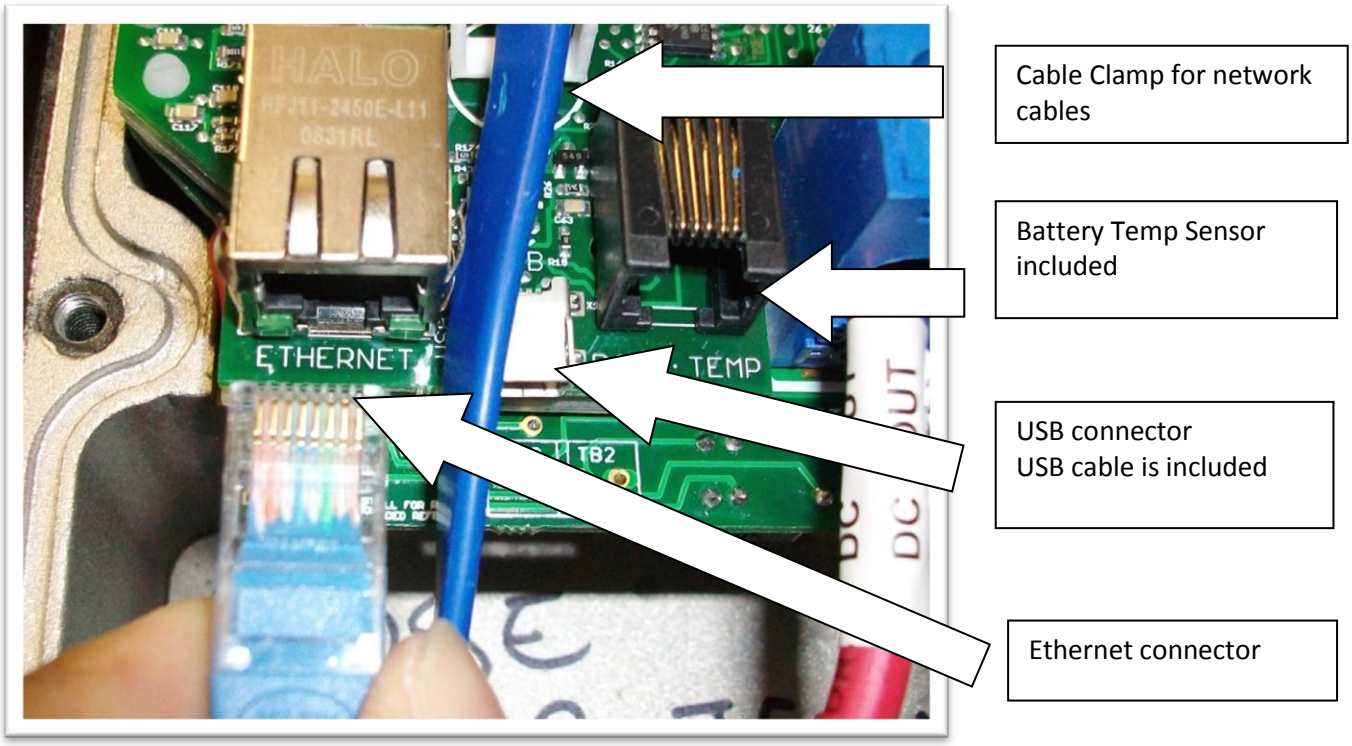


Figure 11

Battery Temperature Sensor Installation

CAUTION - To reduce risk of injury, charge only deep-cycle lead acid, lead antimony, lead calcium, gel cell or absorbed glass mat type rechargeable batteries. Other types of batteries may burst, causing personal injury and damage. Never charge a frozen battery.

WARNING: RISK OF INJURY. To reduce the risk of injury, charge only properly rated (such as 6 V 12 V and 24 V) lead-acid (GEL, AGM, Flooded, or Nickel Cadmium) rechargeable batteries. Other battery types may burst, causing personal injury and damage.

WARNING: Explosion hazard during equalization, the battery generates explosive gases. Follow all the battery safety precautions listed in this guide. Ventilate the area around the battery using ventilators with brushless motors thoroughly and ensure that there are no sources of flame or sparks in the Vicinity.

The Classic comes with a Battery temperature sensor which plugs into the jack beside the DC Terminal connector labeled "Battery Temp". Refer to Figure 1.8 Route the cable through the E-panel into the battery box. Pick a battery in the middle of the bank and about half way up the side of the battery thoroughly clean a spot off on the case. Then remove the protective tape from the sensor and adhere the temperature sensor to the battery. Some manufacturers use a double wall case on the battery. For mounting a temp sensor to them please refer to the battery manufacturer's recommended procedure.

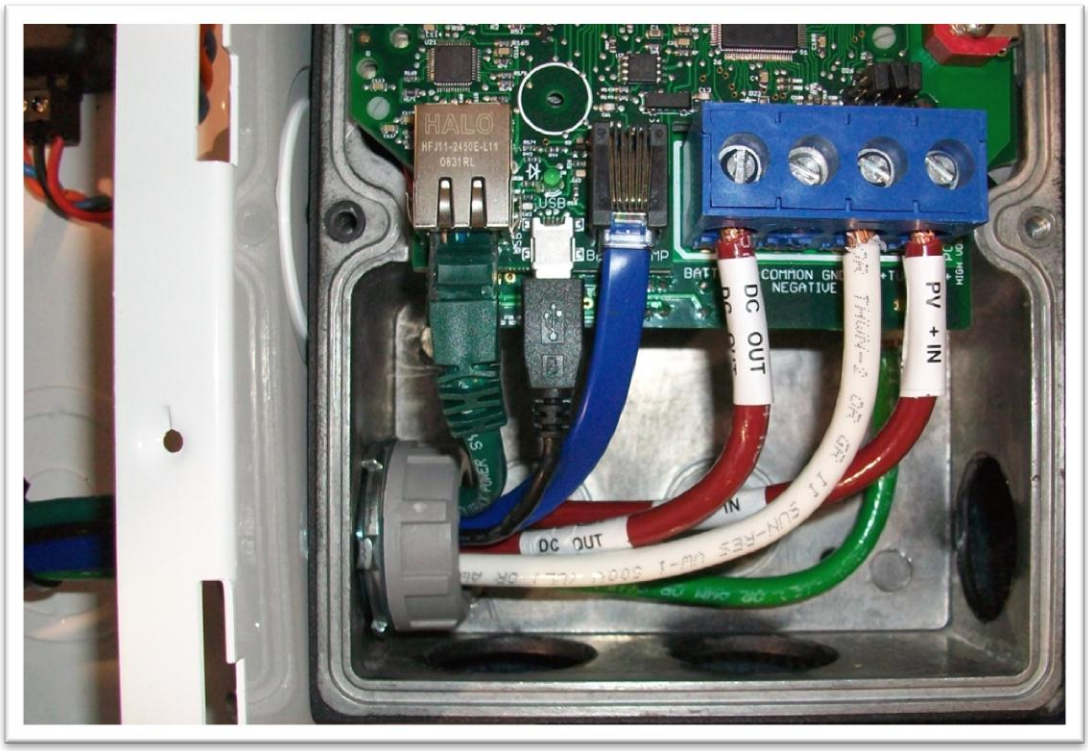


Figure 12

Insert BTS to the jack labeled BATTERY TEMP on the control board.

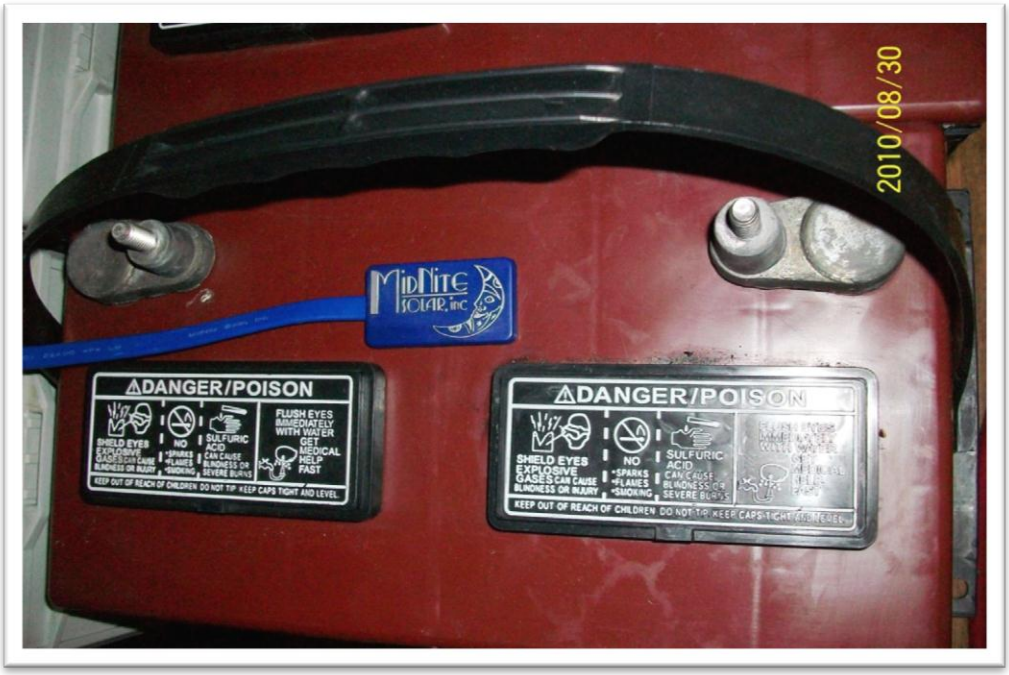


Figure 13

Chassis Grounding

In all installations the Classic chassis should be connected to ground. For systems with a battery breaker sized 60 amps and smaller 10 AWG (6 mm^2) copper is generally sufficient. For systems with a battery breaker sized 100 amps and smaller 8 AWG (10 mm^2) copper is required. For grounding conductor requirements on your specific installation please consult your local electrical code. The chassis grounding terminal is in the upper right corner of the electrical connection compartment see.

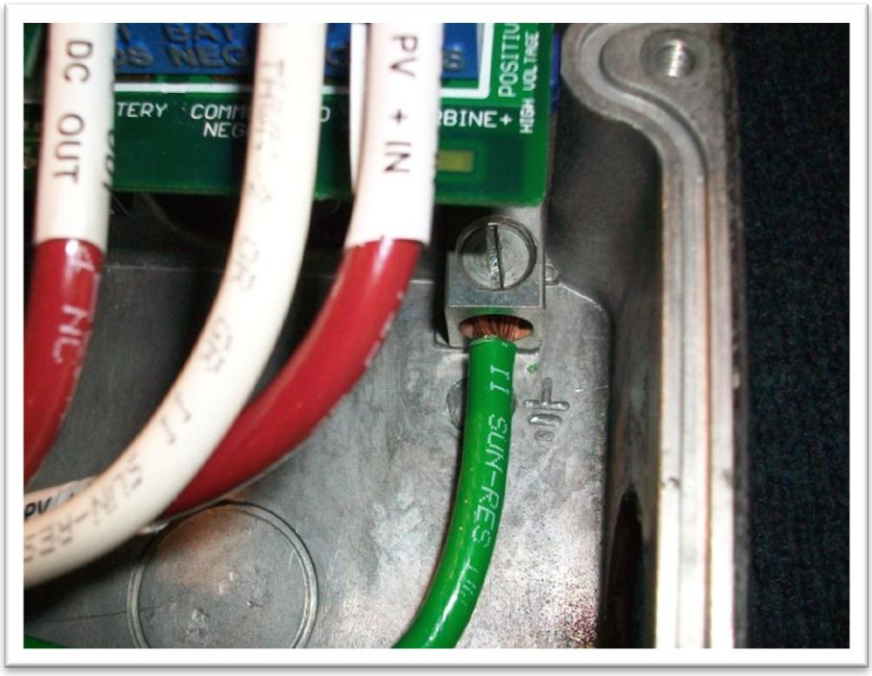


Figure 14

DC System Grounding

The Classic charge controller is designed to work with Negative Ground, Positive Ground or Ungrounded power systems. In grounded systems, dc negative may be connected to ground either externally or by using the Classic's internal grounding jumper, shown on figure 2.1. The internal grounding jumper should only be installed when the Classic's GFP is enabled. In a system with multiple charge controllers the grounding jumper should be installed on every charge controller. In Positive ground or Ungrounded systems the GFP jumper must be removed. See Figure 2.1 Also note that with Positive ground there will be items still referenced to battery negative that can complete a short circuit of the battery bank. These items include but are not limited to the USB Cable and the Ethernet jack. Please contact Technical support for assistance on Positive ground systems.

DC GFP (Ground Fault Protection)

The Classic has internal ground fault protection (GFP) built in. Since 2008 the NEC requires a DC-GFP on all PV systems in the USA. The built in DC-GFP eliminates the need to purchase and install an external DC-GFP. If the internal grounding jumper is installed in a Classic, the battery negative and DC source negative must not be connected to the system grounding conductor anywhere in the system. Grounding of these circuits will defeat the GFP function. In a network with multiple Classics, all Classics must have the internal grounding jumper installed and GFP enabled. The factory setting will make a DC negative to System Ground connection in the Classic charge controller. The GFP function will need to be disabled for Positive ground or an ungrounded DC system.

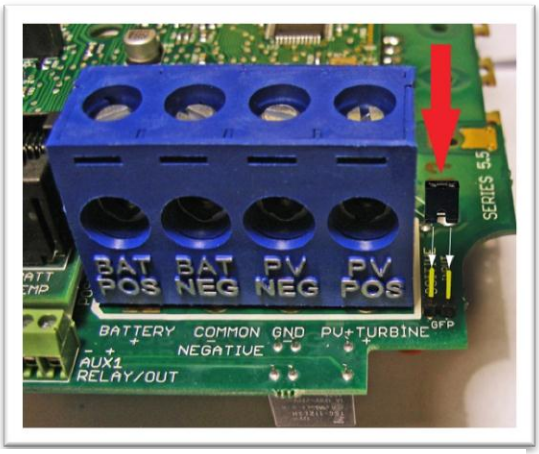


Figure 15

Figure 16

The Ground fault device is simple to understand and use. The Classic DC-GFP works a bit different than others. It detects a fault between battery/PV negative and earth ground just like the breaker DC-GFP system. The difference with the Classic is that it turns off the charge ability and sounds a loud warning when a ground fault is detected. This is different than disconnecting the PV plus circuit. This trick of turning off was first pioneered by another charge control company as an alternative to a $100 external circuit breaker assembly. The Classic's system consists of a PTC that is between the Negative and Ground internally in the Classic. A PTC is basically a type of resistor with a 1 ohm value that when loaded to three quarters of an amp will heat up and go to a very high resistance looking like an open circuit. One of the 3 Classic microprocessors watches the PTC and when it sees a high resistance it will disable the Classic. The ground fault device will then require a manual reset. The PTC is self-healing though so there are no fuses to change. This method meets the requirement for DC ground fault protection in the National Electric Code.

To disable the internal Ground Fault Protection function, the jumper labeled GFP needs to be removed, and the GFP function must be disabled in the TWEAKS menu. See section below for instructions.

To reset the internal GFP function after detection has occurred; fix the actual ground fault, then turn OFF the Classic and turn it back ON. Do this by turning the external battery breaker to OFF position and then to ON position.

Disabling GFP

The GFP feature should only be disabled to operate the Classic in an ungrounded power system or in systems where GFP is not required.

- Press Main Menu
- Scroll to the right or left until TWEAKS is highlighted and press ENTER
- In TWEAKS press the right soft key to get to the MORE menu
- In MORE scroll until GFP is highlighted
- Use the up and down arrow keys to toggle between on and off
- Press ENTER to save

Wiring the Classic

WARNING: Shock hazard. Disconnect the batteries and input power before opening the Classic front cover

When two or more Classics are paralleled onto one DC Source a blocking diode must be used between each Classic and the input source to isolate each Classic from the other ones.

The Classic should be wired by a qualified professional and needs to meet all applicable electrical codes. Always make sure all source and battery circuits are de energized and wait 5 minutes before working on the wiring in the Classic. The Classic has 2 common neutral (negative) terminals. Therefore, only one neutral conductor is required to run from the E-Panel and terminate on either (or both) common neutral terminal. The Positive DC source wire goes to the PV+ Turbine+ screw. The Positive Battery DC wire goes to battery + terminal. Torque the terminal screws to the specs below.

To connect the wiring to the Classic:

- Ensure the DC source and Battery are disconnected
- Connect a grounding conductor between the Classic and system ground
- Ensure the breaker between the battery and Classic meets UL489 standards.
- Ensure the breaker between the dc source and Classic meets UL1077 standards.
- Connect the DC source and Battery wire to the Classic
- Connect any communications cables or auxiliary input/output wires
- Torque terminal connector screws to the following specs

The Torque specs on the DC terminal connector (big blue terminal connector) are:

- Up to #10 AWG torque to 25-35 inch pounds.
- #8 AWG torque to 30-40 inch pounds.
- #6 AWG or above. Torque to 40-50 inch pounds.

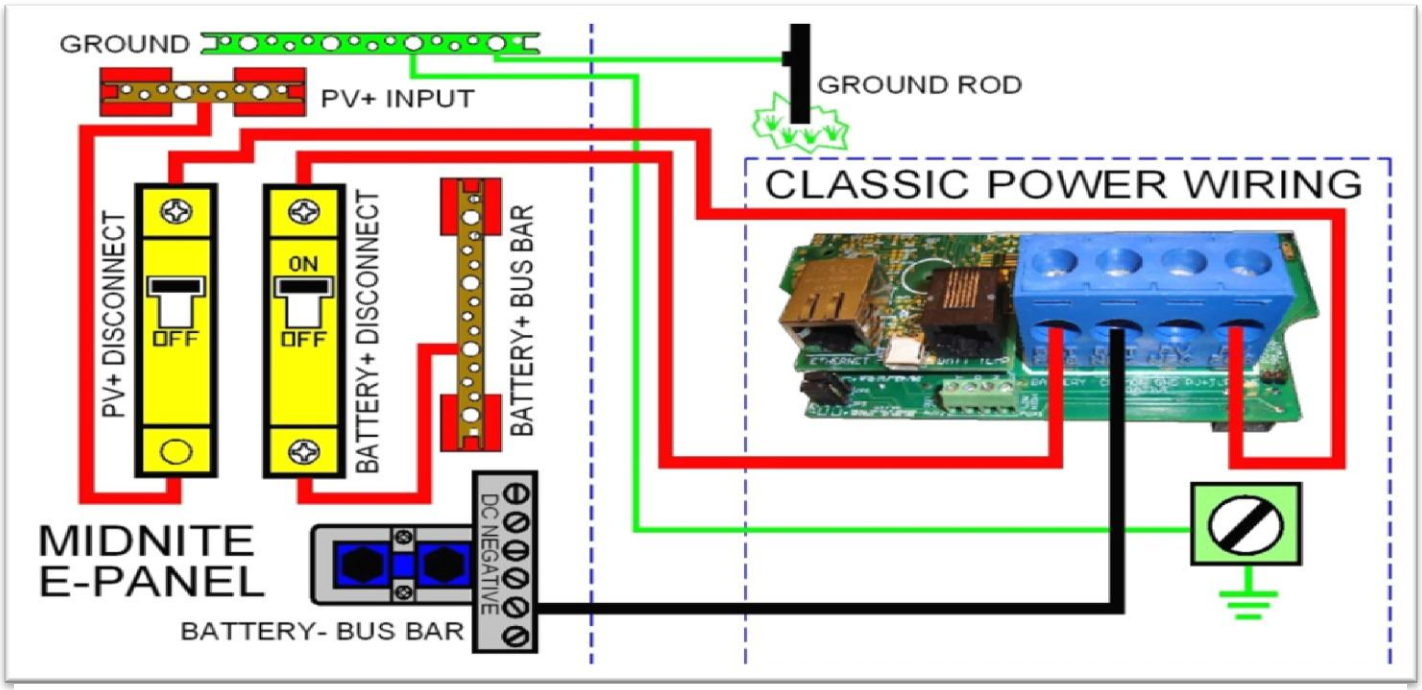

GROUND
PV+ INPUT
GROUND ROD
CLASSIC POWER WIRING
PV+ DISCONNECT
OFF
ON
OFF
BATTERY+ DISCONNECT
BATTERY+ BUS BAR
MIDNITE
E-PANEL
DC NEGATIVE
BATTERY- BUS BAR

Diagram 1

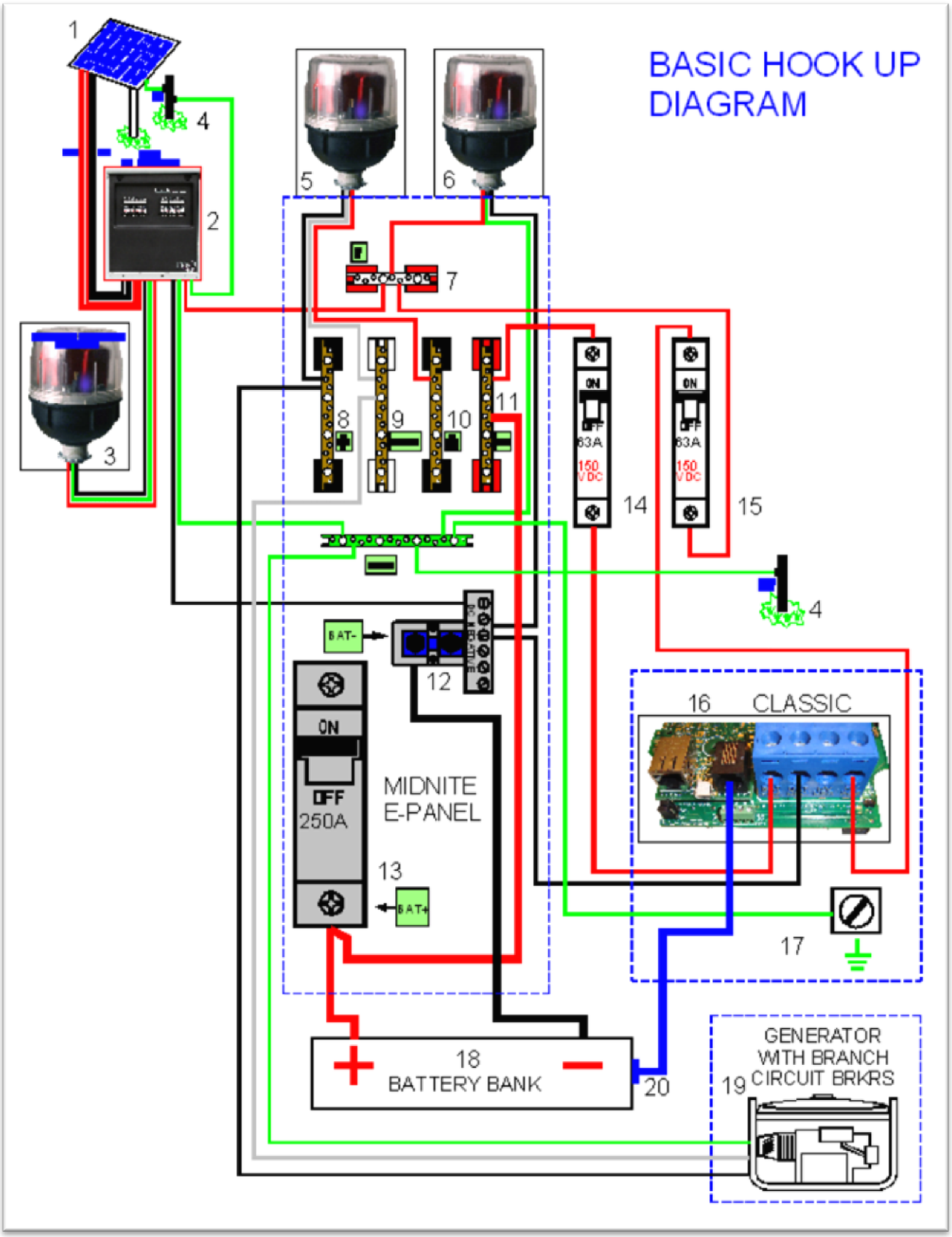

BASIC HOOK UP DIAGRAM
1
2
3
4
5
6
7
8
9
10
11
ON
OFF
63A
150 VDC
14
15
4
BAT-
12
16
CLASSIC
ON
OFF
250A
MIDNITE E-PANEL
13
BAT+
17
18
BATTERY BANK
20
GENERATOR WITH BRANCH CIRCUIT BRKRS
19

Diagram 2

DC Terminal Connector

Figure 17

The Classic's DC terminal connector is located on the circuit board as shown in. The connector will take up to a #4 AWG. #4 AWG THHN when installed in the Classic and MidNite E-Panel is rated for over 100 amps and is therefore suitable for the highest power available from the Classic 150.

Over Current Protection and Wire Size Requirements

The over current devices, wiring, and installation methods used must conform to all electrical codes applicable to the location of installation. Wiring needs to be protected with proper strain relief clamps and or conduit. See page 76 for a breaker and wire size chart.

The network cables, USB cable, BTS cable and auxiliary input/output cables should run in a different conduit to preserve their signal. When installing the Classic in a MidNite E-Panel, it is acceptable to run all wiring through the same knockout hole. It is legal to run signal and power wires together as long as all wiring is listed for the highest voltage to be encountered.

Current Rating

The Classic limits the output current based on the model you have.
The Classic current ratings are:
Classic 150 + 150 Lite - 96 amps maximum
Classic 200 + 200 Lite - 79 amps maximum
Classic 250 + 250 Lite - 62 amps maximum
Classic 250ks + 250ks Lite – 58 amps maximum

Over Current Protection

The Classic must have over current protection to protect wiring from over current events. A means of disconnect must be installed on the DC in and DC out of the Classic. Consult your local codes to determine over current ratings. The breaker between the battery bank and the Classic must conform to UL489. The breaker between the DC source and the Classic must conform to UL1077 or UL489. The NEC requires 1.56 times short circuit current for PV over current protection. This is reduced to 1.25 times when using a breaker rated for continuous duty. All MidNite Solar breakers are hydraulic/magnetic and are rated for continuous duty. No de-rating is required for the output breaker when using MidNite Solar breakers.

PV in particular will be capable of producing more current than its name plate rating in extreme situations so the safe minimum wire size should be selected for the PV array maximum short circuit current. Please consult PV manufacturer for specifications. The US National Electrical Code requires 1.56 times the PV short circuit current for wire size on the PV input. Output wire size follows the NEC guidelines. Typical wire size for output is 6AWG for the Classic250 and 4AWG for the Classic200 and 150 but check all de-ratings for your wire type and installation method.

Long Distance Wire Runs

The Classic offers some unique opportunities if you are faced with longer than normal wire runs between the DC source and the Classic. The Classic comes in 3 input voltage ranges letting you design a DC source at a higher voltage if it is beneficial. For example let's say you have a 300 ft run from a PV array to the Classic you could wire for an open circuit voltage close to 250vdc accounting for the coldest temperature you will encounter. This will allow you to run a smaller gauge wire than with a lower voltage charge controller. The efficiency of a high voltage Classic is less than the lower voltage versions, so you need to weigh the benefit. If this sounds too complicated use this rule of thumb in selecting the proper Classic. PV runs up to 100 feet, use the Classic 150. Runs up to 180 feet, use the Classic 200. Above 180 feet use the Classic 250.

If the wire size between the DC source and the Classic is larger than the Classic's DC terminal connector you can use a splicer block or similar connector to reduce down to #4 AWG close to the Classic. The MidNite E-Panels are supplied with a PV input busbar that accepts up to 2/0 wire.

Connecting the Classic to the Clipper

The connections between the Clipper and Classic are fairly basic. There is the DC – and + conductors from the Clipper to the PV input on the Classic. There is also a smaller set of – and + conductors connecting Auxiliary 2 to the PWM input on the Clipper. To program the Classic to work with the Clipper

the Aux 2 needs to be programmed. Follow the steps below to program this. (Note: see our instructional videos at **www.midnitesolar.com**)
-Enter the Main menu and scroll to Aux and press Enter.
-Scroll to the right to highlight the text under Aux 2 and press the upper right soft key.
-Scroll up or down to find Clipper control and press the right soft key again
-On this screen we need to select AC or DC for the Clipper you have (DC is default)
-Press the right soft key again and here we need to set the absolute voltage we want the clipper to allow
-Press Enter to save this data and press Main Menu until you get back to the Aux 1 and Aux 2 screen
-Set the Text under Aux 2 to say Clipper Control and press Enter.
-Press Status to return to the home screen.

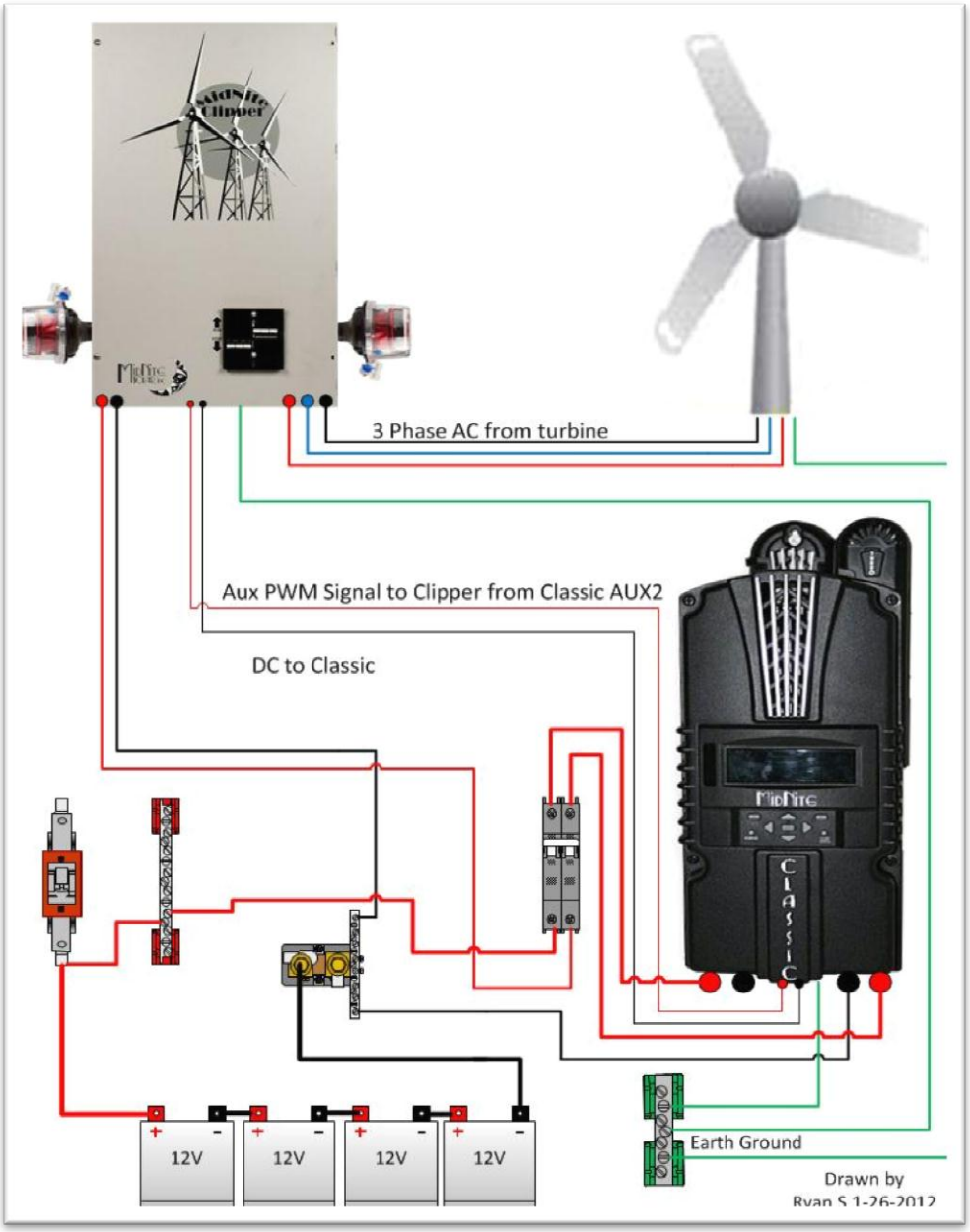


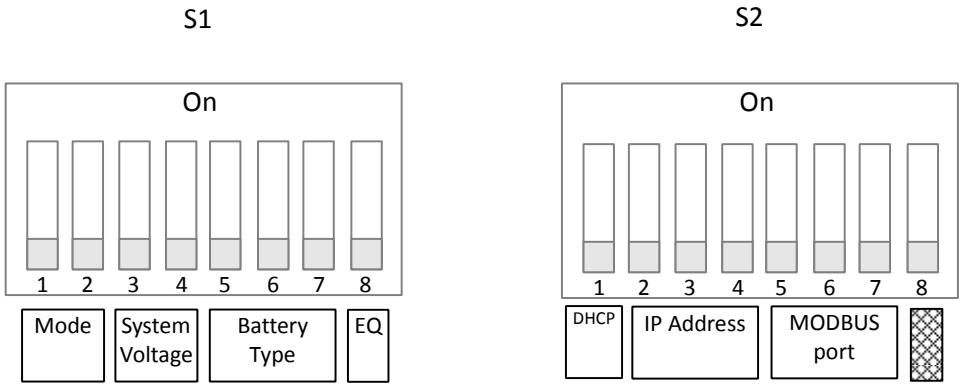
Diagram 3

Maximum and Minimum Wire Size

The Classics Blue DC terminal connector will accept wire from #14-#4 AWG
The Classics Aux 1 and 2 terminal connector will accept wire up to #18 AWG

Equalization Manual and Auto

Equalization with the Classic Lite



Auto Equalize Switch 8

Equalize	
Manual	Off
Auto	On

By setting Auto Equalize to Manual the Equalize intervals in the Battery Settings table are effectively disabled and Equalization stages will have to be started manually.

Please note that not all manufacturers recommend Equalizing AGM batteries. Check with your manufacturer and make sure to DISABLE auto Eq on the Lite if your manufacturer does not recommend Equalizing your AGM batteries

Equlize Button
The Equalize button serves two purposes: the first is to begin an Equalize stage, the second is to clear faults.
Equalization:
An Equalize stage can be scheduled or started at any time by holding the Equalize button down for 2-3 seconds. Holding the the EQ button down for 2-3 seconds at any point once equalization is activated will cancel the equalization stage and return back to the most appropriate battery stage.

When the equalize button is pressed, the EQ light will come on solid. Once Equalize proper starts the light will flash. If Equalization cannot begin immediately then the MNGP Lite will try to engage equalization for 18 hours and then stop if it can't.

See page 60 for the Voltage and Time parameters of EQ.

Equalization with the standard Classic

Manual EQ

To do a manual Equalization charge, Go into the Charge menu and highlight "EQ" and press "Enter". Now "EQ Stopped" will be highlighted. Scroll up to select "Eq Started". Press the "Status" button to return to the home screen. To stop a manual EQ in progress simply reverse the steps above. A manual EQ when started will last for that day unless the Classic is on say Hydro or Wind and the controller never goes to Resting that night, in this case it will stay in EQ until it completes or the controller goes to Resting.

Auto EQ

The Classic can be set up to automatically equalize your batteries periodically, programmed as days between Equalization and the number of days the Classic will try to finish the programmed equalization charge cycle.

To set up Auto EQ go into the CHARGE menu and highlight "EQ" and press "Enter". Now press the SOFT RIGHT key labeled "AUTO EQ". Pressing the AUTO EQ soft key enters the Auto EQ setup menu screen. The left side of the EQ setup menu will show and select the number of days, or "interval" between auto EQ charge cycles. If set to zero (0), it will display MANUAL which is the same thing as DISABLED.

Figure 18

On the right side of the Auto EQ setup menu is the number of DAYS that the Auto EQ will retry if it does not finish the number of Hours and Minutes the Classic has been programmed to EQ for during the first day. For instance you set the Auto EQ for an interval of every 30 days and the RE-TRY for 3 days. Then the first day it attempts an EQ the Classic only accumulates 1 hour of a 2 hour EQ cycle, the next day the Classic will re attempt the EQ cycle. If the Classic still didn't finish the EQ cycle on the 2nd day of its 3 allotted re-try days, it will have one more day to try to finish the Equalize cycle. After this, if it did not complete the 2 hours of EQ time, it will not continue another day. The Classic will show "EQ DONE" on the status screen until either the start of the next day or until the user presses a button on the MNGP to stop it earlier.

At the bottom of the AUTO EQ screen shows the time, in hours and minutes, that the EQ is set for.

Pressing the Soft Right key, labeled "VIEW", takes you to a screen where you can view the interval and re-try counters (timers).

Standard Classic programming

Commissioning the Classic (Quick Start)

The Classic will enter into the Quick Set screens upon initial power up. If the Classic does not enter into the quick set or you want to restore to Factory Default follow these steps to get initiate a Quick Set.

- With the power off to the Classic Hold the left and right arrow buttons down.
- Turn the power on to the Classic and continue to hold the arrow buttons until the setup screen is displayed.
- Answer the questions on the next few screens to complete the Quick Set.

Battery Charge Stages and Meanings

Bulk MPPT
This stage of the Classic means; that the Classic will be putting out as much current as it can to raise the battery voltage to the absorb voltage set point. This is also known as constant current mode.

Absorb
This stage means that the Classic will maintain the absorb set point voltage until the batteries are charged. This stage is terminated at the end of the Absorb time or the End Amps set point whichever is reached first. At this stage the classic is not putting out maximum current, as that would increase the battery voltage over the Absorb set point. This is also referred to as constant voltage mode.
The absorb time is proportional to the bulk time. (i.e. the time bulk takes to reach the absorb voltage.) The battery it's considered "full" at the end of the absorb charge cycle.

Float
A *Float* cycle follows after the *Absorb* cycle is completed; *Float* is displayed on the screen. Battery voltage is held at the float voltage set point.

Equalize
Equalization function can be manually initiated or can be set up to Auto Equalize, refer to page **Error! Bookmark not defined.** for details on setting up EQ. The intent of an equalization charge is to bring all battery cells to an equal voltage by a controller deliberate overcharge. The goal is to return each battery cell to its optimum condition through a series of voltage controlled chemical reactions inside the batteries.

Resting

"Resting" will show on the display when the Classic is not charging the batteries, this is typically due to low light.

Mode is OFF

The Classic is unique, it has multiple charging algorithms for just about any DC input. Because we support such a wide variety of DC inputs we have also added a software "ON" and "OFF" feature. This software "Switch" basically turns the relay off effectively disconnecting the input source so the Classic will not charge the battery. If you see "Mode is Off" in the bottom right corner of the display then the Mode may have got turned off. To turn the mode back "ON" push the Main Menu button several times until "Wizard" is highlighted. Scroll to the right until "Mode" is highlighted and press "Enter". On this screen "OFF" should be highlighted use the up or down arrow to change it to "ON" and press "Enter". Press the Status button once to return to the main status screen.

Note: This is the same menu you would use to change between Charging algorithms IE Solar, Hydro etc

Adjusting Absorb, Equalize and Float Voltages

Absorb, Equalize and Float voltages are fully adjustable. You will need to get the actual voltages from the battery manufacturer. To adjust these voltages follow the steps below.

- Press Main Menu to enter the Main Menu
- Scroll right or left until Charge is highlighted and push the Enter button
- Highlight Volts and press the Enter button
- Use left and right arrows keys to highlight the set point voltage to adjust
- Use up and down arrow keys to lower or raise the voltage
- Press the Enter button to save the new voltages.

Current Limit

The Classic has a current limit component which interacts with the temperature of the charge controller. If the Classic is exposed to extremely hot ambient conditions the output current will be reduced automatically to keep the charge controller safe, if the orange LED comes on, on the MNGP it means that the Classic is in current limit mode. If you believe the Classic is not hot and the orange LED is on, most likely the current limit set point is too low. To check this follow steps bellow.

- Press Main Menu
- Highlight the CHARGE menu and press the Enter Button
- Scroll to LIMITS and press the Enter Button
- Press the right arrow key to highlight "Out Amps" or "In Amps" column
- Use the up and down arrow keys to change the current limit then press the Enter Button to save this data

LED Modes and the "Blinking Red LED"

The Classic may have a Red Blinking LED on its display. This has no effect on the Classic and simply shows it is communicating with the Display. New Classics ship with this disabled. Below we will explain the different LED Modes. To change the LED Mode press the "Main Menu" button repeatedly until "Wizard" is highlighted. Scroll to the right until "Misc" is highlighted and press "Enter". Now scroll to "LED-Mode" and press "Enter". Here you can use the up and down arrows to select the mode you prefer. After selecting the appropriate LED Mode press "Enter" to save this data to the Classic. Pressing "Status" will now bring you back to the home screen.

-OFF – No LED activity no matter what
-Rick Mode – LED Activity for Errors and Warnings only. (Over current, Arc Fault Etc)
-Blinky – basically cycles all the LEDs in a Disco fashion (Useful for Partys)
-LED 1 – LED activity for Warnings and Errors as well as info. A green LED on the display indicates the Classic is in Float. A yellow LED on the display indicates a warning (Over Temp, over current etc). A red LED on the Display indicates an Error (Arc Fault etc). There is also 3 LEDS inside the Classic that can be viewed through the upper vents. The red LED indicates Auxiliary 1 is active. The blue LED is not used at this time and the yellow LED indicates Auxiliary 2 is active

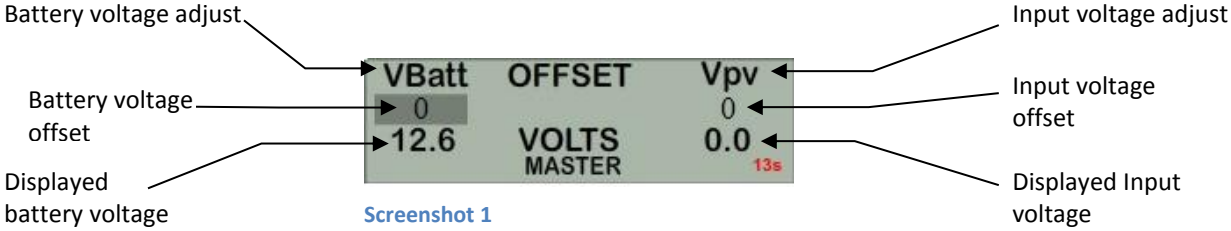
Calibrating Battery and PV Voltage

To calibrate the Classic battery and PV voltage reading, you will need a Volt meter to check the actual battery bank voltage or input PV voltage. Using the volt meter measure the voltage on the DC terminal connector of the Classic (refer to Figure 2.4) compare this reading to the reading on the Status screen in the Classic,(press Status if not in this screen) to adjust the reading of the Classic to the one in the volt meter follow these steps:

- Press Main Menu, scroll to TWEAKS and press Enter
- Highlight VBatt and use the up and down arrow keys to match both of the readings
- Press the Enter button to save

Note. Use the description below to help complete the calibration of the Classic voltages.

TWEAKS screen



Screenshot 1

Configuring DC Input Source

To select the Mode the Classic will run in, follow the steps below.

- Push the Main Menu button.
- Scroll left or right until Mode is highlighted and then push the Enter button.
- Scroll to the right and highlight the current Mode than use the up and down arrows to set the mode you want.
- Take note of the Right soft key most modes have some set points that can be adjusted.
- Press the Main Menu button until you get back to the Mode Menu
- Set the ON/OFF to ON and press Enter

The following Modes will appear in this order in the MODE Menu.

Micro Hydro

This mode is intended for use with hydro systems but can be used with other sources as well. When the Classic first turns on after the input voltage goes above battery voltage, it will sweep from that open circuit voltage down to battery voltage, finding the maximum power point voltage (MPP V). Then return the input to that newly found voltage. After the original turn on sweep, the Classic will do mini sweeps at user adjustable time intervals. If the time interval is set to 0, the Classic will not do any mini sweeps but will stay on this first found MPP V until the user goes to the mode menu and turns it off and back on again.

Micro Hydro mode sweeps slightly slower than Solar mode and has 2 user adjustable settings. Sweep Interval is the time between mini-sweeps, in minutes, and sweeps around the present (i.e. the last found), MPP Voltage. The range of this sweep is determined by the Sweep Depth user adjustment and is expressed as a percentage of Watts that the sweep started from. For example, if in Micro Hydro mode, the Classic was outputting 1000 Watts and the Sweep Depth percentage was set for 20%, (200 Watts), the sweep will bring the input voltage DOWN until the output power drops down to 800 Watts, then will sweep UP in voltage until the power drops again down to 800 Watts and then go back to the newly found MPP Voltage, waiting for the next sweep.

Solar

This is the default mode for PV systems and has a very fast sweep (typically1/2 second or less) that will re-sweep at user adjustable sweep intervals, unless the Classic finds that it needs to do a sweep on its own because of changing conditions. The timed sweep interval is user adjustable and is in units of minutes. SOLAR mode is typically best for PV systems, especially if there is partial shading at times during the day. The Classic will show a message of "PV SHADE" if it thinks the PV array is partially shaded (if this feature is enabled).

SOLAR mode is best suited for shaded or un-shaded PV arrays that are at least one nominal voltage above the battery voltage. For severe partial shading or PV arrays with nominal voltage equal to battery voltage, you may also want to try Legacy P&O (Perturb and Observe) MPPT mode.

Legacy P&O

Legacy P&O (Perturb and Observe) mode is a slow tracking mode similar to the Micro Hydro mode but with the difference that it is slightly faster and will shut off if the power source goes off.
It has 2 settings that are user adjustable. Sweep Interval is the time between mini-sweeps, in minutes, and sweeps around the present (i.e. the last found), MPP Voltage. The range of this sweep is determined by the Sweep Depth user adjustment and is expressed as a percentage of Watts that the sweep started from. For example, if in Legacy P&O mode, the Classic was outputting 500 Watts and the Sweep Depth percentage was set for 10%, (50 Watts), the sweep will bring the input voltage DOWN until the output power drops down to 450 Watts, then will sweep UP in voltage until the power drops again down to 450 Watts and then go back to the newly found MPP Voltage, waiting for the next sweep.

Wind Track

This mode uses a power curve that is either built by the user or one of the pre-installed graphs. The power curve consists of 16 set points that consist of output amperage and input voltage, allowing the user to custom build a curve for their Wind turbine. Please refer to the Wind section of the manual for full details on programming the curve as well as our video that will help in understanding how to adjust these curves using the wind graph editor.

Dynamic

This is typically used for PV (solar) input sources and tries to follow, on a slow dynamic basis, the changing conditions of the input source. This mode has one user adjustment which is a forced sweep perturb trigger interval for times when the input condition changes do not trigger a dynamic sweep. The interval is in units of minutes.

U-Set VOC%

This is a fully manual mode based on a percentage of VOC. The Classic will sweep based on the user set time in minutes and then park at a user set % of the VOC the Classic found on that sweep. This mode is useful for testing or constant voltage sources.

Note: Mode must be manually turned ON after changing the mode. To turn the Mode on highlight the OFF under ON/OFF and switch it to ON. Press enter to save this change.

Configuring the Classic for Wind Input Source

Wind
If you selected "Wind" you will need to select a power curve from the list of pre-loaded curves or build your own. To access the list of power curves follow the steps below.

- Push the Main Menu button.
- Scroll left or right until "Mode" is highlighted and push the Enter button.
- Set the status to OFF and then use the right soft key to select "Graph".

Using the left soft key select "MEM". Now you can scroll up and down through the menu and select from the curve that was designed for your turbine. Once you find the correct power curve use the right soft key

to select "RECALL". Now push the Enter button to save this power curve to the Classics memory.

There are also 9 memory spaces for you to save a custom power curve. To build custom power curves select a memory location between 1 and 9 and hit "RECALL". Use the right and left arrow buttons to scroll through the 16 steps in the custom curve. On each step you can set the amperage by using the up and down buttons. When you have the power curve the way you want it select "MEM". Use the up and down buttons to select a location 1 through 9 to save it in and select "SAVE". Now push the Enter button to save it to the Classic's memory.

For more information consult the videos contained in this DVD as well as the MidNite Solar web site.
Classic-Wind-Graph-Editor-1.mpg

Setting the Date and Time

To set the date and time manually on the Classic follow the steps below.

- Push the Main Menu button repeatedly until Wizard is highlighted.
- Scroll left or right to highlight "MISC" and push the Enter button
- Scroll to "Time" and push Enter

Now scroll left or right to highlight the data you want to manually change. Use the up and down buttons to change the data. When you have all the data changed push the Enter button to save the changes.
The Classic includes a battery in the MNGP portion, to keep the time running even when the power is disconnected. To replace the battery refer to the Installation Manual

Setting Longitude and Latitude

With the built in virtual map, you are able to select where you are in the world. For a more precise setting you can manually enter the longitude and latitude coordinates, geographic location is important because it helps determine when the Classic wakes up and when it goes to sleep. This setting tells the Classic when sunrise and sunset are to happen. The Classic will use this information on future features also. To set longitude and latitude coordinates you need to go thought the WIZARD that is the only way to gain access of this feature

Configuring Auxiliary Input/Output

The Classic includes two auxiliary ports which can be configured to become inputs or outputs. These aux ports can be used as a secondary power supply to be used for accessories such as vent-fan, anemometer and generator starter or even and anemometer. The Aux output is limited to 200ma or less per channel. These aux ports if used correctly could extend the system life. Here is an explanation of how they work.

- An internal, re-settable Positive Temperature Co-efficient (PTC) fuse protects the AUX internal components from overcurrent or a short circuit.
- AUX 1 consists of either RELAY or LOGIC operation depending on the user selection function.
- AUX 2 could be set to become an INPUT or OUTPUT. One at a time this port could be reading the state of a device connected and takes an action from there.

Screenshot 2

To configure the Classic's Aux ports:

- Push the Main Menu button
- Scroll left or right to highlight "AUX" and push the Enter button.

Scroll left or right to highlight the relay you wish to change. Push the right soft key labeled "SETUP". Scroll up or down to change the function of the relay. Select the right soft key to set the parameters of the function. When finished push the ENTER button to save the changes.

Main Aux Screen shows both Aux1 and Aux2 functions

Off -	Places output to Low state (0 Volts)
Auto -	Selects the assigned function to the Aux output or input
On -	Sets output for Low state (12 Volts or Relay On)

Table 5

The Following is a list of the Aux 1 and 2 functions with brief descriptions of their function.

Aux 1

Vent Fan Lo

This mode will turn Aux 1 off above the voltage set point you program. It allows you to run a vent fan for a battery bank based on battery voltage. There is a voltage set point that you set and Aux 1 will turn off when the battery reaches that set point. The voltage has to fall 2 tenths of a volt below the set point for 30 seconds before Aux 1 will turn back on.

Vent Fan High

This mode will turn Aux 1 on above the voltage set point you program. It allows you to run a vent fan for a battery bank based on battery voltage. There is a voltage set point that you set and Aux 1 will turn on when the battery reaches that set point. The voltage has to fall 2 tenths of a volt below the set point for 30 seconds before Aux 1 will turn off.

Float Low
This mode will turn Aux 1 off whenever the Classic is in Float. Aux 1 will stay off until the Classic falls 3 tenths of a volt below the float voltage set point.

Float High
This mode will turn Aux 1 on whenever the Classic is in Float. Aux 1 will stay on until the Classic falls 3 tenths of a volt below the float voltage set point.

Clipper Control
This mode was intended to control the MidNite Clipper. It will send out a PWM signal whenever the controller is unloading the turbine because the battery is full or close to it. There are no adjustment in this mode the Classic is preprogrammed with the best parameters to control turbine RPM.

Day Light
This mode will turn Aux 1 on at sunrise and turn it off at sunset based on the PV input voltage.

Nite Light
This mode will turn Aux 1 on at sunset and turn it off at sunrise based on the pv input voltage.

Toggle Test
This mode will cycle Aux 1 for 1 second off and 1 second on repeatedly. This mode is mostly for testing purposes.

Pv V on Low
This Mode will turn Aux 1 off above a user set voltage based on the input voltage to the Classic (V High) and turn Aux 1 on when it hits a low voltage set point (V Low). It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 off after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 on after reaching the V Low set point. This mode can be useful for controlling a failsafe stopping system for Hydro or Wind.

Pv V on High
This Mode will turn Aux 1 on above a user set voltage based on the input voltage to the Classic (V High) and turn Aux 1 off when it hits a low voltage set point (V Low). It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 on after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 off after reaching the V Low set point. This mode can be useful for controlling a failsafe stopping system for Hydro or Wind.

Opportunity Lo
This mode will turn Aux 1 off when the Classic gets within a certain range of the voltage set points for each charging stage (V High) and turn Aux 1 on when it gets to a low set point (V Low). These set points are user adjustable and will allow the Absorb, Float and EQ timers to continue to run. You will adjust these set points to negative numbers and the numbers are an offset from the voltage set point. For example

a -.2 would turn Aux 1 off 2 tenths of a volt below your set points. This mode will allow you maximum diversion while maintaining your 3 stage charging. It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 off after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 on after reaching the V Low set point.

Opportunity Hi

This mode will turn Aux 1 on when the Classic gets within a certain range of the voltage set points for each charging stage (V High) and turn Aux 1 off when it gets to a low set point (V Low). These set points are user adjustable and will allow the Absorb, Float and EQ timers to continue to run. You will adjust these set points to negative numbers and the numbers are an offset from the voltage set point. For example a -.2 would turn Aux 1 on 2 tenths of a volt below your set points. This mode will allow you maximum diversion while maintaining your 3 stage charging. It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 on after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 off after reaching the V Low set point.

Low bat disc

This mode will turn Aux 1 off when it reaches a set point based on battery voltage (V High) and turn it on at another set point based on battery voltage (V Low). It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 off after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 on after reaching the V Low set point. This can be used with a NC relay when the battery gets to the set point the Classic will send 12vdc to the relay holding it open and disconnecting the load.

Diversion

This mode will turn Aux 1 on when it reaches a set point based on battery voltage (V High) and turn it off at another set point based on battery voltage (V Low). It also allows you to set a delay time in seconds the Classic will wait before turning Aux 1 on after reaching the V High set point. It also allows you to set a hold time in seconds the Classic will wait before turning Aux 1 off after reaching the V Low set point.

Aux 2

Float Low

This mode will turn Aux 2 off whenever the Classic is in Float. Aux 2 will stay off until the Classic falls 3 tenths of a volt below the float voltage set point.

Float High

This mode will turn Aux 2 on whenever the Classic is in Float. Aux 2 will stay on until the Classic falls 3 tenths of a volt below the float voltage set point.

Day Light

This mode will turn on Aux 2 at sunrise and turn it off at sunset based on the PV input voltage.

Nite Light

This mode will turn on Aux 2 at sunset and turn it off at sunrise based on the pv input voltage.

Clipper Control

This mode was intended to control the MidNite Clipper. It will send out a PWM signal whenever the controller is unloading the turbine because the battery is full or close to it. There are no adjustment in this mode the Classic is preprogrammed with the best parameters to control turbine RPM.

Pv V on Low

This mode is PWM based and is just reverse logic of Pv V High. It would be comparable to using the NC contacts of the relay used in Pv V High. It can be used that way with a solid state relay with NC contacts for a failsafe load.

Pv V on High

This mode is PWM based and will PWM Aux 2 above a user set voltage (V High) based on the input voltage to the Classic and stop when it hits a low voltage set point (V Low).

Toggle Test

This mode will cycle Aux 2 for 1 second off and 1 second on repeatedly. This mode is mostly for testing purposes.

Opportunity Lo

This mode is PWM based and is just reverse logic of Opportunity Hi. It would be comparable to using the NC contacts of the relay used in Opportunity Hi. It can be used that way with a solid state relay and NC contacts to do diversion above a set voltage.

Opportunity Hi

This mode is PWM based and will PWM Aux 2 when the Classic gets within a certain range of the voltage set points for each charging stage (V High) and stop when it gets to a low set point (V Low). These set points are user adjustable and will allow the Absorb, Float and EQ timers to continue to run. You will adjust these set points to negative numbers and the numbers are an offset from the voltage set point. For example a -.2 would turn Aux 2 on 2 tenths of a volt below your set points. This mode will allow you maximum diversion while maintaining your 3 stage charging.

Diversion Lo

This mode is PWM based and is just reverse logic of Diversion Hi. It would be comparable to using the NC contacts of the relay used in Diversion Hi. It can be used that way with a solid state relay and NC contacts to do diversion above a set voltage.

Diversion Hi

This mode is PWM based and will PWM Aux 2 at a set point based on battery voltage (V High) and stop it at another set point based on battery voltage (V Low).

Aux 1 Function

OUTPUT = Relay or 12V/0V Signal jumper selectable
Aux 1 has the relay so Diversion functions must operate slowly

VENT FAN LOW	Aux1 on below setpoint
VENT FAN HIGH	Aux1 on above setpoint
FLOAT LOW	Aux1 off when in Float
FLOAT HIGH	Aux1 on when in Float
CLIPPER CONTROL	PWM Control for Cipper
DAY LIGHT	Aux1 on at dawn off at dusk
NITE LIGHT	Aux1 on at dusk off at dawn
TOGGLE TEST	Aux1 cycled 1 sec interval
Pv V ON LOW	Aux1 on below Pv in setpoint
Pv V ON HIGH	Aux1 on above Pv in setpoint
OPPORTUNITY LO	Divrt based on chrg state lo
OPPURTUNITY HI	Divrt based on chrg state hi
LOW BAT DISC	Disc load based on bat volt
DIVERSION	Slow Diversion control

Aux 2 Function. Output/Input

OUTPUT = 12V/0V Signal

FLOAT LOW	Aux2 off when in Float
FLOAT HIGH	Aux2 on when in Float
DAY LIGHT	Aux2 on at dawn off at dusk
NITE LIGHT	Aux2 on at dusk off at dawn
CLIPPER CONTROL	PWM Control for Clipper
Pv V ON LOW	PWM sig below Pv in setpoint
Pv V ON HIGH	PWM sig above Pv in setpoint
TOGGLE TEST	Aux2 cycled 1 sec interval
OPPORTUNITY LO	PWM divert rltv chg state lo
OPPORTUNITY HI	PWM divert rltv chg state hi
DIVERSION LO	PWM Divert on Bat voltage lo
DIVERSION HI	PWM Divert on bat voltage hi

To set/ change threshold voltage as well as time do the following:

- When in the function you wish to use press the right soft button
- This will take you to the VOLTS menu here is where you set your threshold voltage
- Use the left and right arrow keys to navigate through the options
- Use the up and down arrow keys to raise or lower the threshold voltage
- To change the time press again the right soft button to get to the TIME menu
- In this menu do the same as you did in the VOLTS menu, until desired adjustments are made
- Press ENTER to save

Aux 1 and Aux 2 Graphs/Jumpers

Figure 3.0

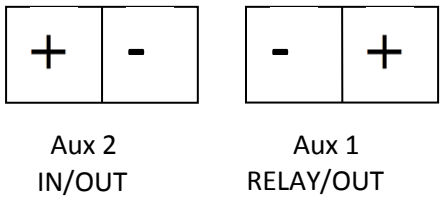


Figure 3.0 shows the two Aux port terminals, with their respective Polarities. These terminals are located at the bottom of the Power board below the battery temperature jack. Use a mini flat head screw driver to tighten the screws. The jumpers are described in the section below.

In order to select operation of Aux 1 between relay contact or 12v output JP6 and JP8 need to be configured accordingly following the instructions provided in this section.

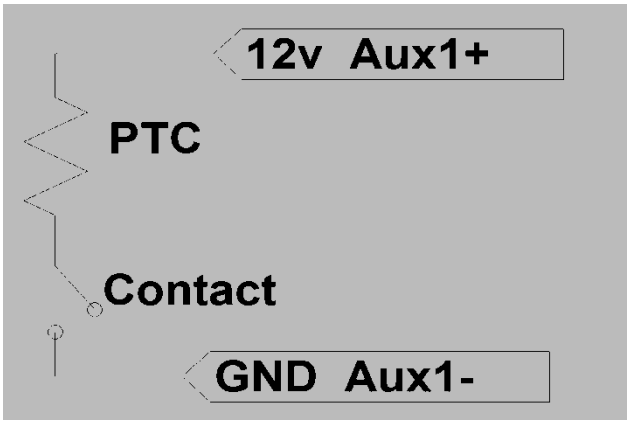


Diagram 4

When Aux 1 is used to supply 12v out, JP6 and JP8 have to be in the position shown in Figure 3.1. The basic schematic of how this works is shown in Figure 3.2. The 12v out is more like 14.5v. The maximum current from Aux 1 should not exceed 200mA. The Aux 1 output can be set to operate at either Active High (12V) or Active Low (0V) when the Aux 1 function condition is true. For more information see Configuring Auxiliary Input/Output on page 36.

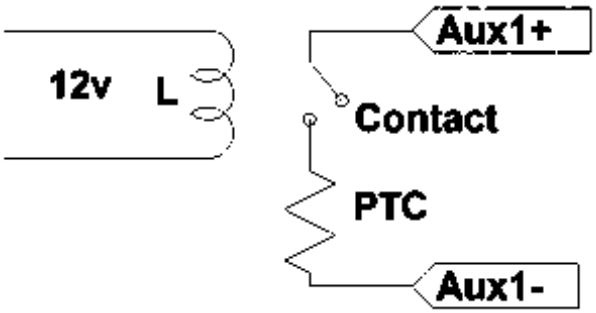


Diagram 5

To configure Aux 1 to use the internal relay, JP6 and JP8 have to be in the position shown in Figure 3.4. This configuration is commonly known as "dry contact" because it does not provide 12v at the Aux1 terminals; it acts more like an isolated switch (to the ratings of the relay). The Aux 1 output can be set to operate at either normally open, (Active High) or normally closed (Active Low) when the Aux 1 function condition is true. For more information see Configuring Auxiliary Input/Output on page 36.

Aux 1 Voltage-Time Relation (Relay/12v)

Aux 1 Function Graph shows the relationship between voltage and time of AUX 1. (The axis labeled VOLTAGE could be battery, PV, wind input voltage, etc. depending on the function selected by the user) VHIGH is the upper voltage limit, as soon as the voltage reaches this limit the Delay time will then start, as soon as the Delay time expires AUX1 will change state and stay there until the voltage drops below VLOW set point, then another timer called Hold Time will start and when this expires the output will go back to the original state.

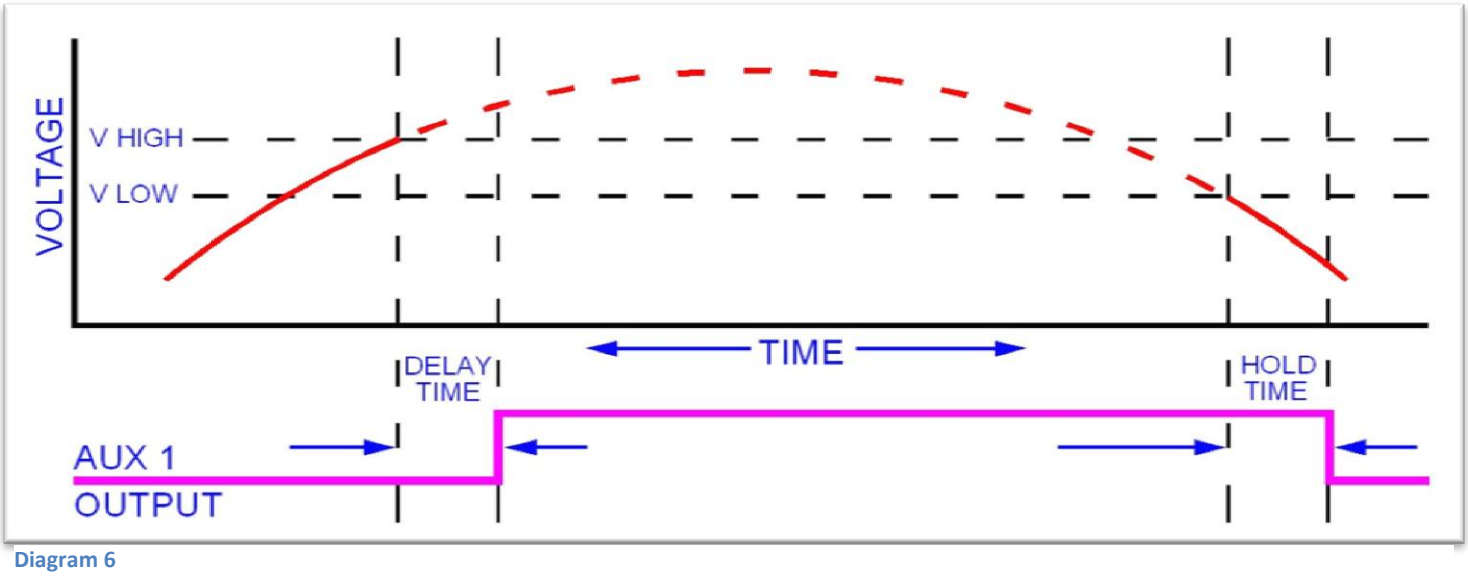


Diagram 6

Aux 2 Voltage-Time Relation (PWM)

The graph below describes the relation in Aux 2, between voltage and time. The difference in Aux 2 is the use of PWM running at a hundreds of Hz rate and is suitable for use with Solid State Relays (SSRs). The way this works is: user sets a desired threshold and a width voltage, this means that at the desired voltage (VOLTS), the aux will start to PWM and it has to go above or below the width to completely change states (from 0v to 12v, or from 12v to 0v depending on the user selection, active high or active low). This gives a much smoother transition. For more information see; *Configuring Auxiliary Input/Output*. Page 29

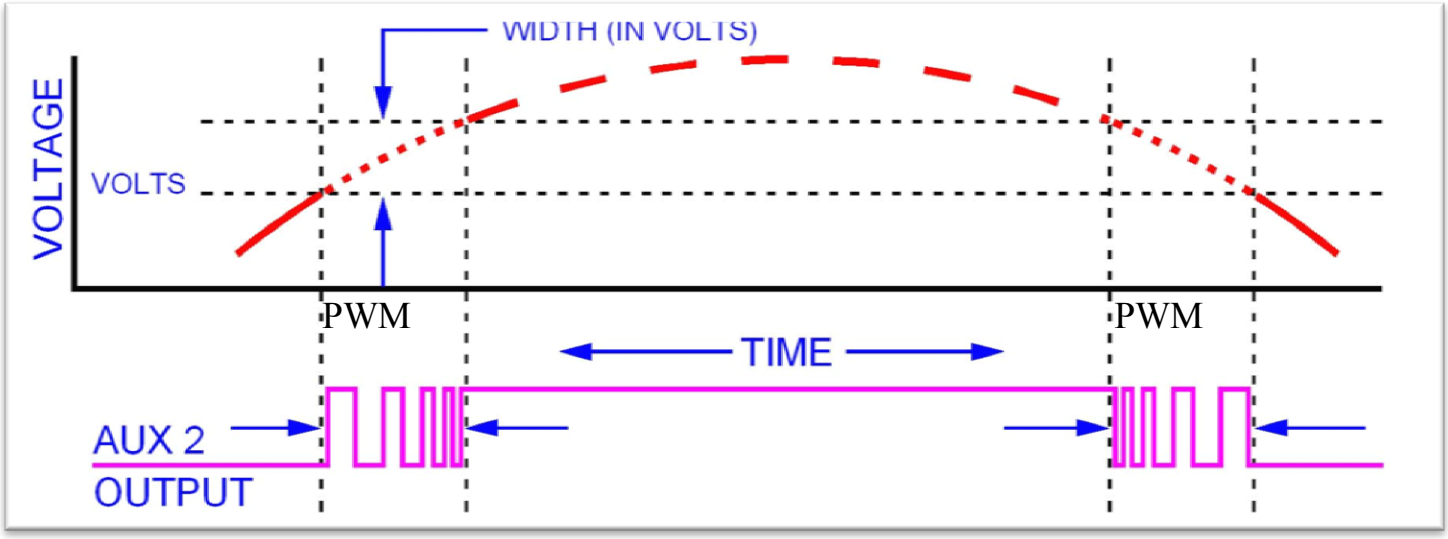


Diagram 7

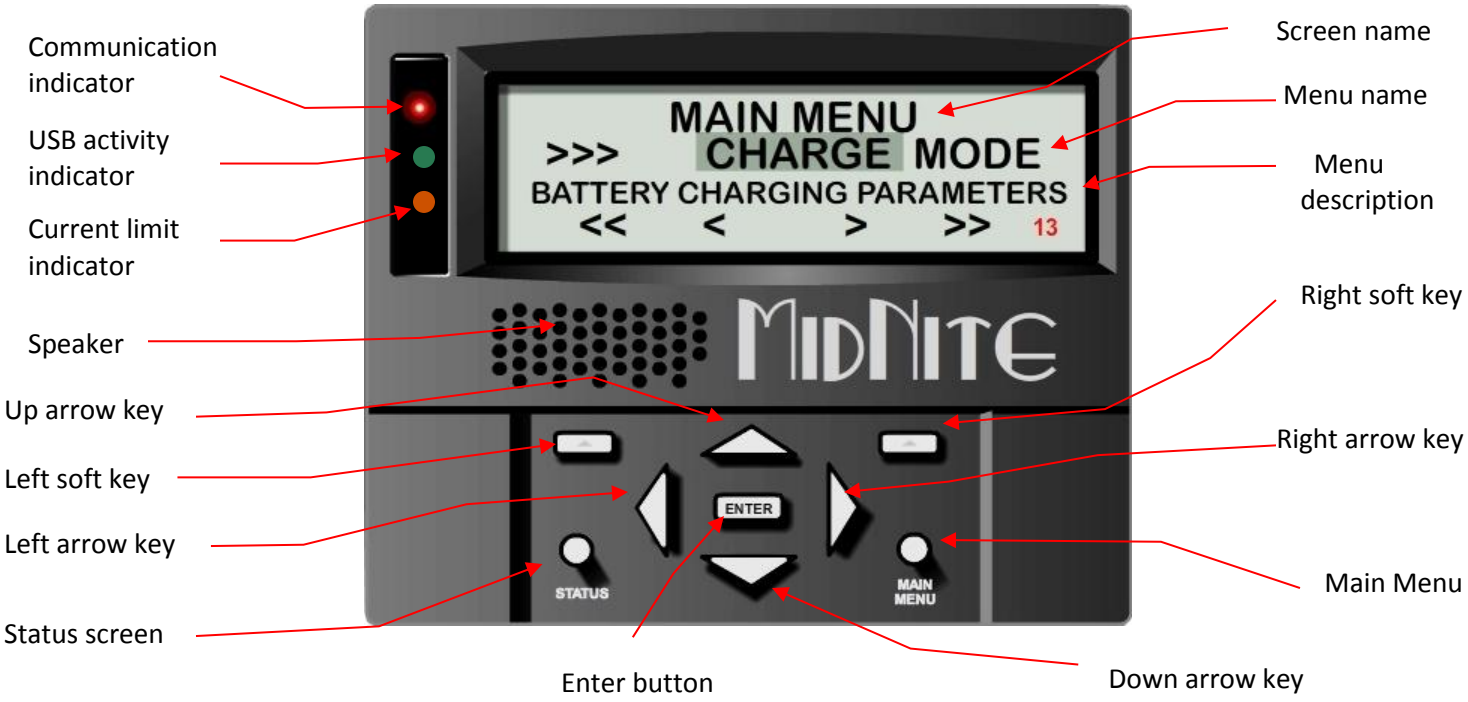
Setting the MNGP features

The Classic comes with an integrated "MidNite Graphics Panel" (MNGP), which is the primary interface to the Classic. Setting up contrast, backlight and volume its simple just follow the steps below.

- Push the Main Menu button.
- Scroll left or right to highlight "Misc" and push the Enter button.
- Use the left and right arrow keys to select the feature to set and press the Enter button
- Press the up and down buttons to adjust
- Press Enter to save

Use diagram below for MNGP reference.

Figure 19



Navigating the Menu's

- Push MAIN MENU
- Push right and left buttons to see the different menus
- To return to the status screen push STATUS button

* To navigate from one end of the main menus to the other end push the top right and left buttons
Below the name of the menu is a description of the menu. Pushing the left and right buttons will enable you to see all the main menus provided. Inside some of these main menus will be sub-menus to adjust the parameters of the selected feature.
Here is an overview of these menus:

<<CHARGE —MODE—AUX—MISC—LOGS—TWEAKS—TEMPS—NET>>

Below each of the menu names is a row with a description of the menu inside. To enter a menu, the name of the menu has to be highlighted. Pushing ENTER will show the submenus. The up and down arrow keys are enabled for easier navigation. Highlighting a sub menu and pushing ENTER will take you inside the submenu where you will be able to change the parameters of the unit. To get out of the submenus push MAIN MENU, this will take you out of the submenus one at a time every time you push it. See page 44 for entire Menu Map.

Viewing Other MidNite Products on the Display

Coming Soon…….

Connecting Classic to Two MNGPs/Network cable

The Classic can be controlled with two MNGPs at the same time. This will help when the Classic is in a shop and there is a considerable distance between the Classic and the controlling point (office, inside house, garage etc.). Instead of going to the Classic to check status or to change a setting, the user can run a cable to the controlling point and see the Classic in a second MNGP. The cable is a six wire phone cable. Connect one side of the extension cable to the jack in the Classic labeled SLAVE/OUT and the other end to the second MNGP. Since the Classic transmits power and data signals through the phone cable to the MNGP the length of the cable is limited to 100ft.

MidNite Solar only offers a 3ft as an optional accessory. If you are making your own cable be sure be sure to insert cable end all the way into the phone terminal to get a good contact. Use the phone crimping pliers to crimp both ends of the cable.

Figure 20

Figure 21

We recommend using flat phone cable for extension, just because it is easier to work with. Use the two pictures above as reference. Make sure the color and position of the wires are as shown in the diagram

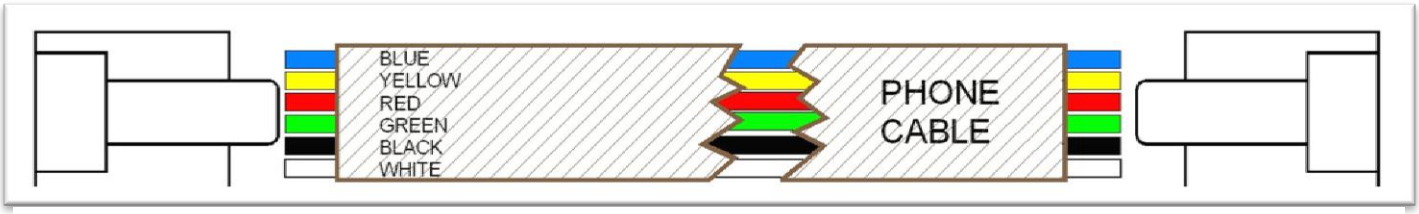


Diagram 8

below. Use terminal connector tab as reference.

Arc Fault

The Arc Fault Detector is a unique safety component included in every Classic, because safety is not an option, the engineers at MidNite take action as the 2011 NEC code requires. The Classic is the first charge controller in the

world to successfully stop a series arc. The Classic can detect an arc in less than 100mSec. From low power arcing to devastating high power arcing, the Classic will detect and shut down with an audible and visible alert to announce that there is a problem in the PV side of the system. When an arc is detected the Classic has to be manually cleared.

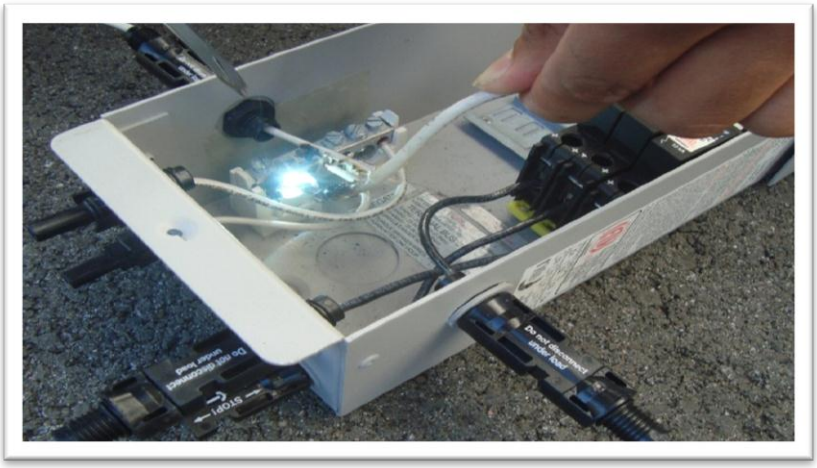
Resetting the Arc Fault Detector after detection has occurred: The First thing to do is find and fix the actual arcing wire, terminal, splice etc. The Classic needs to be powered down completely for 15 seconds and then powered back up. Do this by turning the DC source (PV, Wind or hydro etc.) breaker off. Then turn off the external battery breaker. Than simply turn the 2 breakers back on starting with the battery breaker.

The arc fault module has three adjustable parameters consisting of: MODE, TIME & SENSITVY
MODE: Is assigned as a 1 from factory default and it should stay that way unless instructed by MidNite Solar.

TIME: This sets the length of the arc the Classic has to monitor before tripping the Arc fault detection.
This parameter is set to 4 from the factory.

SENSITIVITY: This parameter determines how sensitive the Arc fault detector will be 1 being the most sensitive and 15 the least. This parameter is set to 10 from the factory.

Figure 22



If you experience nuisance tripping you can raise the sensitivity one digit at a time. Follow the instructions below to make adjustments or disable Arc fault. As a last resort, you may disable Arc fault if your system cannot work with the arc fault detector.

To change the parameters of the Arc Fault, follow the steps below:

- Press Main Menu
- Scroll to the right or left until TWEAKS is highlighted and press ENTER
- In TWEAKS press the right soft key to get to the BITS menu
- In BITS press the right soft key to get to ARC ADJ
- In this menu use the left and right keys to select the feature to adjust
- Use the up and down arrow keys to change the parameters

In order for the Classic to read the new settings you must power cycle the Classic. Do this by turning the DC source (PV, Wind or hydro etc.) breaker off. Then turn off the external battery breaker. Than simply turn the 2 breakers back on starting with the battery breaker.

View Faults and Warning's

The Classic has some helpful safety features including the GFP (Ground Fault Protection) and AFD (Arc Fault Detector). When one or more faults are detected the Classic will stop outputting power and display a fault message in the bottom right corner of the home screen (STATUS).

View Logged Data

The Classic logs 380 days' worth of data in its memory. The data logging in the Classic has two modes and frequency of data capture.

DAILY HISTORY
Is captured once each day and is saved at night, after 2 hours of no activity when the PV input voltage is below battery voltage for solar, or in modes that do not necessarily rest at night, like wind or hydro, the capture will happen once every 24 hours. Data logged each day is kilo-watt-hours, Float time in hours and minutes, the maximum power output for the day, maximum FET temperature inside the unit, maximum PV or input voltage and maximum battery voltage for the day.

HOURLY HISTORY
Also referred to as "Short term History" is captured once every five 5 minutes anytime the Classic is not resting (when it is charging). Data logged every 5 minutes is power, input voltage, battery voltage, Charging Stage, amps out and kW-Hours.

A time and date stamp is associated with each data entry in both Daily and Hourly history logs. The main time/date stamp for each data logging mode is Date for daily history and Time for recent history although both time and date are stored and displayed for each logging mode.

Screenshot 3

When entering the "LOGS" menu, you will see two items displayed there. The top line is lifetime kW-Hours for the Classic and below that is time spent in float today. (Note: Float, Absorb, Bulk and EQ time is also viewable in the "TIMER VU" sub-menu of the "ChgTime" menu in the main CHARGE menu) Pressing the SOFT LEFT key enters the DAILY history data viewing menu. Similarly, pressing the SOFT RIGHT key enters the HOURLY recent history data viewing menu.

In the DAILY menu, the LEFT side category of information displayed can be changed by pressing the UP or DOWN arrow keys. Switching over to the RIGHT side of the screen by pressing the RIGHT arrow key highlights the DAY change key. Pressing the UP key decrements the date (goes back 1 day) and displays that capture date above the word "DAY". There are 380 days of information stored in the Classic. After 380 days are captured and stored, the oldest data stored will be overwritten as new daily data fills in as the most recent data.

Screenshot 4

The HOURLY log menu (actually captured every 5 minutes), works very similar to the DAILY log menu, except that the time stamp above the word TIME is the time, shown in 24 hour format, that the data was captured that day. The category of data captured is of course more suited for minute by minute capture rather than the maximum data statistics captured on a day by day basis in the DAILY log screen. The left side of the recent history text log screen can be individually viewed by selecting the left side and pressing the UP/DOWN arrow keys to show the power, voltages, charge stage etc and various information captured at the time shown on the right side time selection.

Screenshot 5

At the bottom of the DAILY text log screen, the TIME the maximum statistics were stored is shown, whereas at the bottom of the HOURLY text log screen, the DATE of the capture is shown. Again, if for some reason the year of the time stamp was less than 2011, the time/date will alternate between INVALID and the time/date stamped along with that data and does not necessarily mean the data itself is not correct. If the data is all zeros and the year is shown as 2000, the data IS most likely invalid and not correct or the logging memory has not been filled yet. This is why the Classic powers up with the year 05/04/2003... It means that data was actually logged but the date was not set, whereas if it is showing 00/00/2000 it will normally mean that the data is just zero and therefore invalid data as well as invalid time and date.

The upper right corner of the text log screens displays a number from 1 to 380. This number shows the index or position of the data in the 380 data log time slots. The most recently stored data has an index of 1. Two data points ago shows an index of 2, etc. This index goes for either Daily History or Recent History text log viewing screen.

Graphical Logging Display modes

Both DAILY and HOURLY logging can also be viewed in a graphical manner. While in the text viewing log screen, pressing the Soft Right key labeled "GRAPH" will bring up this view screen. The HOURLY view is also available in the main status cycle of screens, changed by repeatedly pressing the STATUS key, just after STATUS TWO screen. This is labeled as "SHORT TERM HISTORY" in the STATUS screens.

A summary of the next Status screen will be shown while holding the status button before releasing it and entering that next status screen. This also goes for the Recent History graph screen in Status.

Each data point shown in the graphical view screen is shown as a dot. There are a maximum of 96 dots, appearing horizontally per screen with some information about each dot shown on the left side of the screen. An individual data point can be selected for investigation by moving a small, flashing once per second vertical cursor horizontally across the graphed data by using the Left and Right arrow keys. The most recent data is shown on the right most side of the first screen. The cursor first appears around 20 dots or data points from the right side of the first screen. (About 20 data points ago in history)

To scroll the data viewed one third of a screen to the left, hold the "Shift" key, the "Soft Left button", down and tap the "Left arrow key". Each press of this combination of buttons will scroll the graphical view horizontally another 1/3 screen. Holding the Shift key and Right arrow key on the most recent data screen will push the cursor up against the right side and onto data point one.

Pressing the Up arrow button will change the data viewed to the next category. For instance, in the Recent history graph screen, the displayed data will change from Power to input voltage, battery voltage and kW-Hours. Pressing the Down arrow key will bring the category of data back down again. A very brief 5 or 6 character annunciator displayed in the upper left corner tells us what category of data the graph is showing us. The number just below this 5 or 6 character descriptions is the actual number in volts or watts or applicable unit of data displayed at that cursor position centered on the dot of the graph. The third line down on the left side of the recent data screen shows the time stamp of that data where the cursor is positioned on the graph. Finally, the bottom left of the graph screen alternates between two indicators. One is the charge stage at the cursor position and the other is the scaling of the vertical axis of the graph. Power for instance, can show a very wide range of values and power lends itself better to using a logarithmic vertical scale, shown as LOG. Voltage and other data shows up fine using a LINEAR vertical axis scale and is spelled out on the lower left of the graphic screen.

Screenshot 6

The Date of the particular selected cursor positioned data point is shown on the bottom middle of the graphic screen. Moving the cursor left or right using the Left and Right arrow keys, selects the next data points to the left or to the right of the present cursor position.

The flashing cursor is short and may be hard to detect at first so you may have to look for it. The cursor aligns and centers itself right on the dot itself that is selected.

The bottom date or time displayed may tend to obscure the data line graphed behind it. The time/date and the graph data will be mixed together about a second after the date/time is drawn on the bottom of that graph log screen. If, for some reason, the graphic log screen display shows bogus data or dots that look like they should not be shown, simply press the Enter button and the screen will be quickly erased and re-drawn without the extra lines or dots.

There may or may not be any valid data past a certain point to the left if the unit is fairly new. The data shown in unused spots may be zero, or it may be off the screen and not viewable. As time goes on and new data is acquired, those unused data points will start to appear and be valid. Of course, the Daily history will take many days to fill in, where the Recent hourly (minutes really) data will fill in after a few hours or maybe a day or two depending on how long the Classic is on and running for that day. Remember, the Classic does not normally log data while it is in "Resting" mode.

Dealer Information Screen

For dealers' convenience the Classic has a display screen that can be modified to publicize the dealers' business information. This is helpful because the customer will know who to contact in case they want to report any problems regarding the product. This will also help to promote retailers' accessories that are compatible with the Classic. This screen is capable of 20 characters per row and four rows, for a total of 80 modifiable characters.
To modify this display screen, follow these steps:

- Press main menu
- Scroll to MISC and select it
- On the following screen, select MNGP and press enter
- On this screen select LOAD DEFAULTS press enter
- On the password select 365 and press enter
- Using the up and down keys will allow you to change the alphabet characters
- Now scroll left and right to go to the next character block
- Do this until your desired message is complete
- Press enter to save on the classic memory

Classic Lite Programming

The Classic Lite is based on our Classic charge controller. It has all of the same features, Power and versatility minus only the Graphic Display, and arc fault detection.

It still has all of the other advanced features found in the Classic, and can be used in all of the same applications. For the advanced features to be accessed and programmed, you will need to use the included Local Application software and a PC, or a MidNite Solar MNGP Graphics Panel, or the Graphics panel of another Standard Classic in the system. If desired, the Classic Lite can be used with an MNGP instead of the supplied MNLP controller.

LED explanations

The Lite control panel (MNLP) has 6 status LEDs to indicate various modes of operation as well as faults. There are 3 behind the small window on the upper left.
The top Orange status LED will light solid to indicate that the controller is in Bulk Charge mode.
The center Yellow status LED will light solid to indicate that the controller is in the absorption stage.
The lower Green LED will light solid to indicate that the controller is in Float and blink slowly to indicate the controller is Resting due to low light.
All 3 of these status LED's will blink slowly to indicate "Wrong Code" please see trouble shooting on page 71 for help with this.

There are also LED indicators for Current limit, Ground Fault and Equalize.

All LEDs blinking slowly indicate a loss of communication with the Classic. Check that the cable is plugged in to the top Jack on the Classic. If error persists try another cable or call Tech support for assistance.

Figure 23

Programming

There are four separate ways to program a Classic Lite.
1-The programming is done using Dip Switches under the front cover of the MNLP.
2-The Classic Lite can be programmed with an independent MNGP.
3-The Lite can be Networked with a standard Classic and programmed using the standard Classic's MNGP
4-The Classic Lite can be programmed using the Local App (Through the Ethernet connection) software included on the DVD or available at www.midnitesolar.com

Dip Switches

Below you will find an Explanation of the Dip switches and the values associated with their settings. Up is on and down is off on the switches. To access the Dip switches you need to remove the front cover on the Lite display panel. Firmly grasp the left and right side of the cover and slide it off.

Figure 24

Now you will need to use the supplied tool (Toothpick) to place all 15 switches in the correct position. All the information on the switches can be found on the labels on the MNLP as well as in the tables below. Keep in mind if any of the switches are set to Custom the Lite display becomes a LED display only and you will need to use the included PC software or a MNGP to program the Classic. Please see page XX in the Appendix for info on using the "Local App" software in conjunction with a PC.

Note: The Classic Lite will need to be programed in "Custom Mode" for all applications other than Solar.

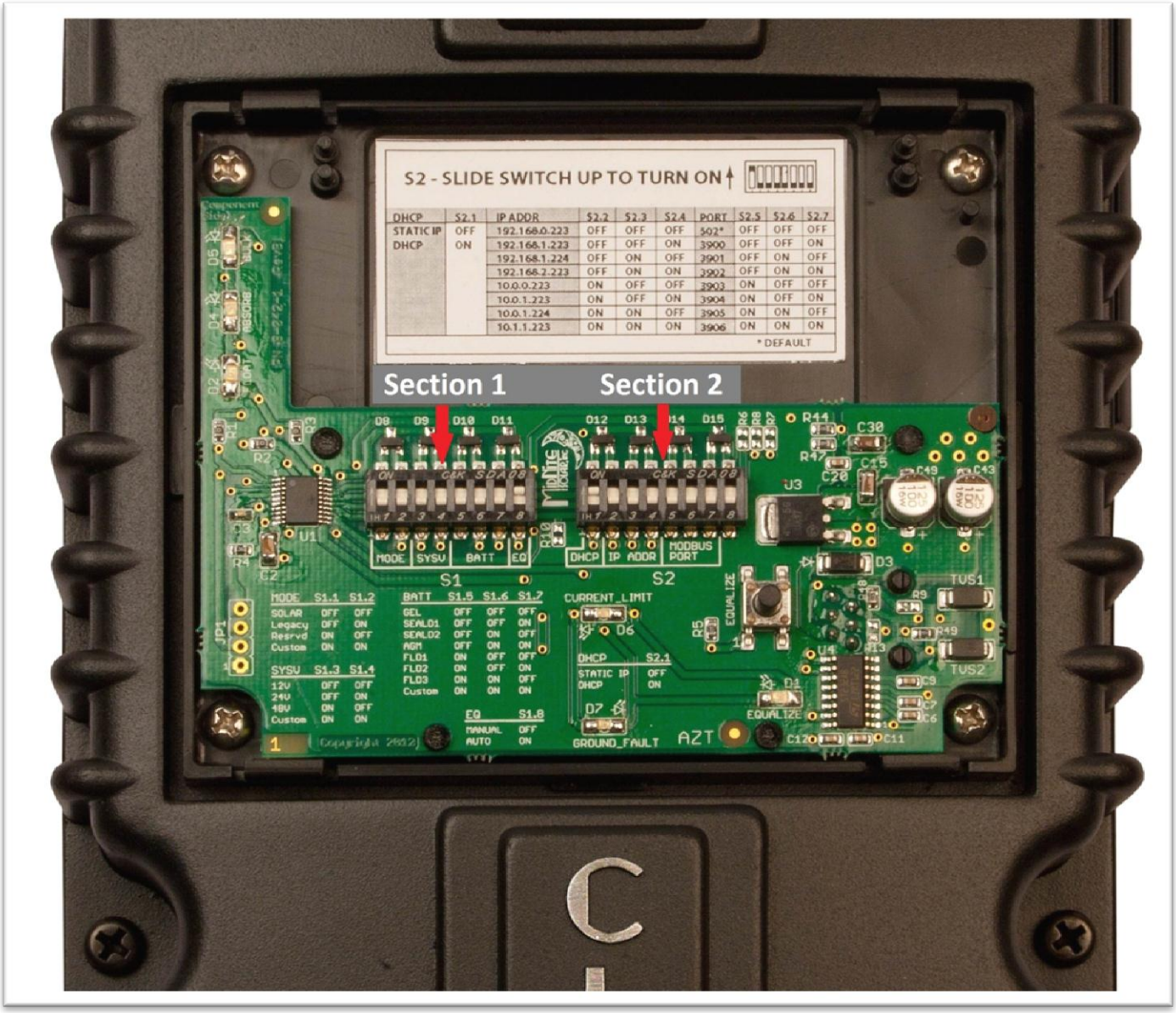


Figure 25

Section 1 Switch settings explained

Mode: Switches 1 and 2 (Section 1)

On Section 1, the first 2 Switches are used to select which Solar Mode will be used.

For "Solar" Mode: set switches 1 and 2 to OFF . This is the optimum setting for virtually all solar installations.

For "Legacy " Mode: Set Switch 1 to OFF and Switch 2 to On.

Legacy Mode can be used in cases where the Open Circuit Voltage is close to the battery voltage. For example, a 22 volt open circuit array and a 12 volt battery. Or where there are mixed sizes of panels in an array. (Solar Salad)

When switch 1, 2, 3, and 4 are set to ON, the Lite is in "Custom Programming mode" and can be programmed using any of the other 3 methods.

Custom set up will be required for Wind, Hydro, Fuel Cell applications as well as setting up the Aux. output controls and for Battery voltages of 36, 60, and 72 (84, 96, 108, and 120 volt batteries for KS model)

System Voltage: Switches 3 and 4 (Section 1)

On Section 1, set Switches 3 and 4 to the appropriate positions (Found in the Chart) corresponding to your system's battery voltage. 12, 24, and 48 volt systems are included in this menu. 36 and 72 volt battery set up can be accomplished using the Custom set up method. (84, 96, 108, and 120 volt batteries for KS model)

Battery Type: Switches 5, 6, 7 (Section 1)

Switches 5, 6, and 7 allow you to select from 7 different battery types and charging profiles. These profiles can be found in the 2 charts on the following pages. These should cover most common applications. If slightly different voltages are desired, this can be done using Custom Mode and programming methods 2, 3, or 4.

Auto Equalize: Switch 8 (Section 1)

Switch 8 is used to select Automatic equalization.
In the OFF position, a manual equalization cycle, if desired, is selected by pressing the "Equalize" button on the MNLP for 3 seconds. To Cancel Equalize, Press Equalize button for 3 seconds.

With Switch 8 in the ON position, the Lite will attempt to equalize the batteries automatically.
The equalize interval is dependent upon the battery type selected. Please refer to:
"Dip switch battery settings for 12, 24, or 48 volt batteries" for specific information on this function.

Section 2 Switch settings explained

DHCP or Static IP address Switch 1 (Section 2)

On Section 2, Switch 1 when on will enable DHCP. This will allow the Router on the network to assign the Classic Lite an IP address. When off it sets the Classic to a static IP address that will be determined by Switches 2, 3 and 4.

IP Address Switches 2, 3 and 4 (Section 2)

On Section 2, Switches 2, 3 and 4 will set the Static IP Address of the Classic Lite to the address shown in the table below if Switch 1 is set to Off for Static IP.

ModBus Port Switches 5, 6 and 7 (Section 2)

On Section 2, Switches 5, 6 and 7 set the ModBus port of the Classic Lite. The values that correspond to the switches are found in the table below.

The actual Labels that are on the inside of the MNLP.

S1 - SLIDE SWITCH UP TO TURN ON

MODE	S1.1	S1.2	SYSV	S1.3	S1.4	BATT	S1.5	S1.6	S1.7	EQ	S1.8
SOLAR	OFF	OFF	12V	OFF	OFF	GEL	OFF	OFF	OFF	MANUAL	OFF
LEGACY	OFF	ON	24V	OFF	ON	SEALD1	OFF	OFF	ON	AUTO	ON
RESRVD	ON	OFF	48V	ON	OFF	SEALD2	OFF	ON	OFF		
CUSTOM	ON	ON	CUSTOM	ON	ON	AGM	OFF	ON	ON		
						FLD1	ON	OFF	OFF		
						FLD2	ON	OFF	ON		
						FLD3	ON	ON	OFF		
						CUSTOM	ON	ON	ON		

S2 - SLIDE SWITCH UP TO TURN ON

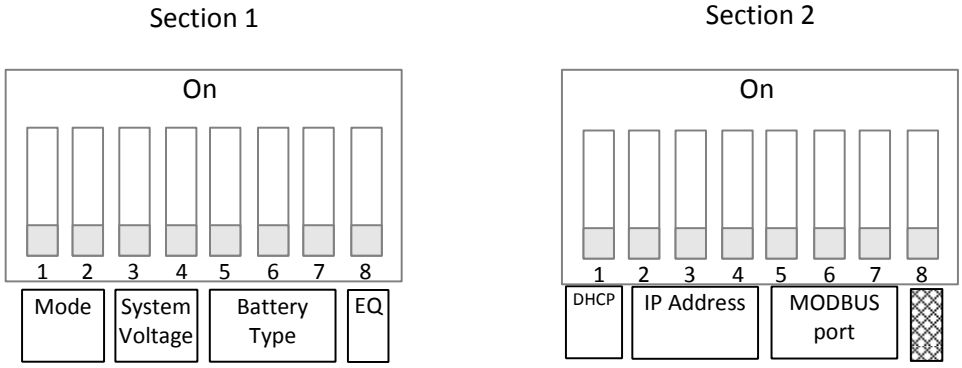
DHCP	S2.1	IP ADDR	S2.2	S2.3	S2.4	PORT	S2.5	S2.6	S2.7
STATIC IP	OFF	192.168.0.223	OFF	OFF	OFF	502*	OFF	OFF	OFF
DHCP	ON	192.168.1.223	OFF	OFF	ON	3900	OFF	OFF	ON
		192.168.1.224	OFF	ON	OFF	3901	OFF	ON	OFF
		192.168.2.223	OFF	ON	ON	3902	OFF	ON	ON
		10.0.0.223	ON	OFF	OFF	3903	ON	OFF	OFF
		10.0.1.223	ON	OFF	ON	3904	ON	OFF	ON
		10.0.1.224	ON	ON	OFF	3905	ON	ON	OFF
		10.1.1.223	ON	ON	ON	3906	ON	ON	ON

* DEFAULT

10-194-1 REV - DCA 4-06-12

Table 6

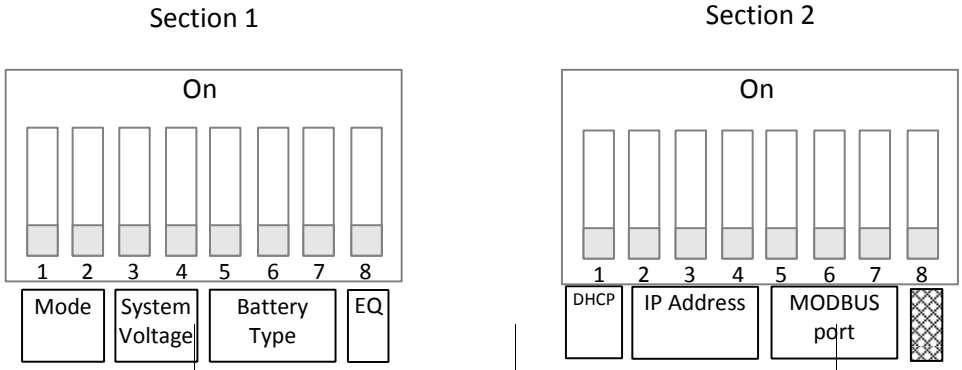
Section 1 Switches 1through 8



Section 1			
Mode			
Mode	**Switch 1**	**Switch 2**	
Solar	Off	Off	
Legacy	Off	On	
Reserved	On	Off	
Custom*	On	On	
System Voltage			
System Voltage	**Switch 3**	**Switch 4**	
12V	Off	Off	
24V	Off	On	
48V	On	Off	
Custom*	On	On	
Battery Type			
	Switch 5	**Switch 6**	**Switch 7**
Gel	Off	Off	Off
Sealed 1	Off	Off	On
Sealed 2	Off	On	Off
AGM/Flooded	Off	On	On
Flooded 1	On	Off	Off
Flooded 2	On	Off	On
Flooded 3	On	On	Off
Custom*	On	On	On
Auto Equalize			
	Switch 8		
Manual	Off		
Auto	On		

Table 7

Section 2 Switches 1 through 7



Section 2 DHCP or Static IP address			
	Switch 1		
Static IP	Off		
DHCP	On		
IP Address (only if DHCP is set to Static IP)			
	Switch 2	**Switch 3**	**Switch 4**
192.168.0.223	Off	Off	Off
192.168.1.223	Off	Off	On
192.168.1.224	Off	On	Off
192.168.2.223	Off	On	On
10.0.0.223	On	Off	Off
10.0.1.223	On	Off	On
10.0.1.224	On	On	Off
10.1.1.223	On	On	On
MODBUS Port			
	Switch 5	**Switch 6**	**Switch 7**
502 (default)	Off	Off	Off
3900	Off	Off	On
3901	Off	On	Off
3902	Off	On	On
3903	On	Off	Off
3904	On	Off	On
3905	On	On	Off
3906	On	On	On

* Setting any value to custom effectively disables the MNGP Lite as a controller (LED's and Equalize button still work) and requires you to configure the Classic using a PC or MNGP.

Table 8

Battery voltage and time settings

Battery Type	Absorb Voltage	Float Voltage	Equalize Voltage	Absorb Minimum Time (minutes)	Absorb Maximum Time (minutes)	Equalize Time (minutes)	Equalize Interval (days)[3]
12 Volt battery							
Gel	14.0	13.7	-	30	90	-	-
Sealed 1	14.2	13.7	14.4	30	90	60	28
Sealed 2	14.3	13.7	14.6	30	90	60	28
AGM	14.4	13.7	15.1	30	120	120	28
Flooded 1	14.6	13.5	15.3	30	120	120	28
Flooded 2	14.7	13.5	15.4	30	120	120	28
Flooded 3	15.4	13.4	16.0	30	180	180	14
Custom	-	-	-	-		-	-
24 Volt battery							
Gel	28	27.4	-	30	90	-	-
Sealed 1	28.4	27.4	28.8	30	90	60	28
Sealed 2	28.6	27.4	29.2	30	90	60	28
AGM	28.8	27.4	30.2	30	120	120	28
Flooded 1	29.2	27	30.6	30	120	120	28
Flooded 2	29.4	27	30.8	30	120	120	28
Flooded 3	30.8	26.8	32	30	180	180	14
Custom	-	-	-	-		-	-
48 Volt battery							
Gel	56	54.8	-	30	90	-	-
Sealed 1	56.8	54.8	57.6	30	90	60	28
Sealed 2	57.2	54.8	58.4	30	90	60	28
AGM	57.6	54.8	60.4	30	120	120	28
Flooded 1	58.4	54	61.2	30	120	120	28
Flooded 2	58.8	54	61.2	30	120	120	28
Flooded 3	61.6	53.6	64	30	180	180	14
Custom	-	-	-	-		-	-

[3] If **Auto Eq** is set to **Auto** then the Equalize interval is in effect. If **Auto** Eq is set to **Manual the** Equalization stage will not occur unless started manually.

Table 9

Using MNGP Remote to program a Classic Lite

The Classic Lite can be programmed using an MNGP remote. This is an easy way to get into and program not only the basic functions, but the advanced features as well. In Dip Switch Section 1set DIP Switches 1, 2, 3, and 4 to ON. This will tell the Classic Lite's MNLP display to allow custom programming, Next, remove the plug from the back of the MNLP and plug it into the MNGP. Now, you basically have a Standard Classic. The programming for this is found in the Standard Classic Manual. (Included on the DVD you got with your Lite) Once programmed in this way, the MNGP can be removed, and the MNLP replaced. All functions, and voltages programed into the Classic will now be retained in permanent memory.

Programming the Lite with a Networked Standard Classic

The third method of programming is to use a Standard Classic in the system to program the Lite in a simple "Follow-Me" network. In Dip Switch Section 1set DIP Switches 1, 2, 3, and 4 to ON. This will tell the Lite's MNLP display to allow custom programming. You will need to use the MNGP from the standard Classic to set the Address and Follow-Me parameters. See the Follow-Me section for full details.

Programming the Lite with the Local App

You can use the Local Application software that was included with the Lite to program it as well. You will need the serial number of the Classic to unlock the 2 way functionality of the Local App. Please see the Local App instructions for more details.

Clearing Faults

If either the Ground Fault or Current Limit fault light is lit, then the equalize button can be tapped to clear these faults. If the fault condition has not been removed, however, then the light will re-illuminate indicating that a fault condition is still present.

Notes on the Lite

If anything is set to Custom, then the MNGP lite will not send any programming data to the Classic. So a Custom setting effectively disables MNGP Lite Control over the Classic requiring the user to use a PC or MNGP to configure the Classic.

Note: The Custom setting still allows full function of the LED's and the EQ button

Explanations of Solar and Legacy

Solar
This is the default mode for PV systems and has a very fast sweep (typically1/2 second or less) that will re-sweep at user adjustable sweep intervals, unless the Classic finds that it needs to do a sweep on its own because of changing conditions. The timed sweep interval is user adjustable and is in units of minutes. SOLAR mode is typically best for PV systems, especially if there is partial shading at times during the day. The Classic will show a message of "PV SHADE" if it thinks the PV array is partially shaded (if this feature is enabled).
SOLAR mode is best suited for shaded or un-shaded PV arrays that are at least one nominal voltage above the battery voltage. For severe partial shading or PV arrays with nominal voltage equal to battery voltage, you may also want to try Legacy P&O (Perturb and Observe) MPPT mode.

Legacy P&O
Legacy P&O (Perturb and Observe) mode is a slow tracking mode similar to the Micro Hydro mode but with the difference that it is slightly faster and optimized for Solar. Legacy mode can be very usefull for arrays that experience heavy shading issues as well as PV arrays that have a low voltage. If the array has a VOC (Open Circuit Voltage) of less than 125% of the battery voltage Solar mode will not work as well so Legacy will be a better choice.

Uploading New Firmware to the Classic

The Classic has the ability to have its firmware updated with the included USB cable and a Windows based PC. Please see www.midntesolar.com and click on the Firmware tab for the firmware and instructions. Do to the various different Windows configurations we will not go into detail in the Classic Manual. The Firmware upgrade is fail safe so if the wrong code is installed the Classic simply says "Wrong code" prompting you to load the correct code. Also if the upload is interrupted for whatever reason simply start over.

WARNING ! The Classic's USB port is NOT isolated from battery negative. This is typically only an issue on positive ground systems or systems with a tripped ground fault protection device. Care must be taken that a computer connected to the Classic's USB port is either isolated from ground and the Classic's negative or that the computer's USB negative is common with the Classic's negative and ground.

Figure 26

Prepare Classic charge controller for update.

1. Now go to your electrical panel and identify the input and output breakers for the Classic. Turn them off. Wait 3 minutes for the Classic to de-energize.

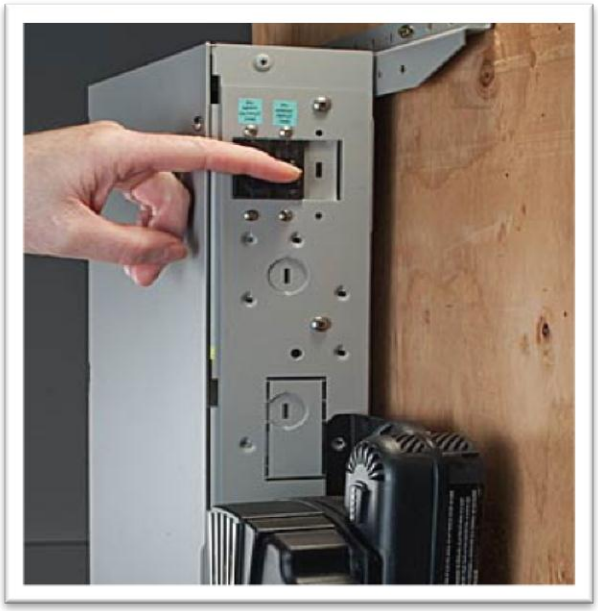


Figure 27

2. Remove the four screws holding the front cover of the Classic charge controller. **Do not let the front cover hang by the cable.**

Figure 28

3. Holding the front cover with one hand, place a screw in the top left hole of the front cover and screw it into the top right hole of the back casting.

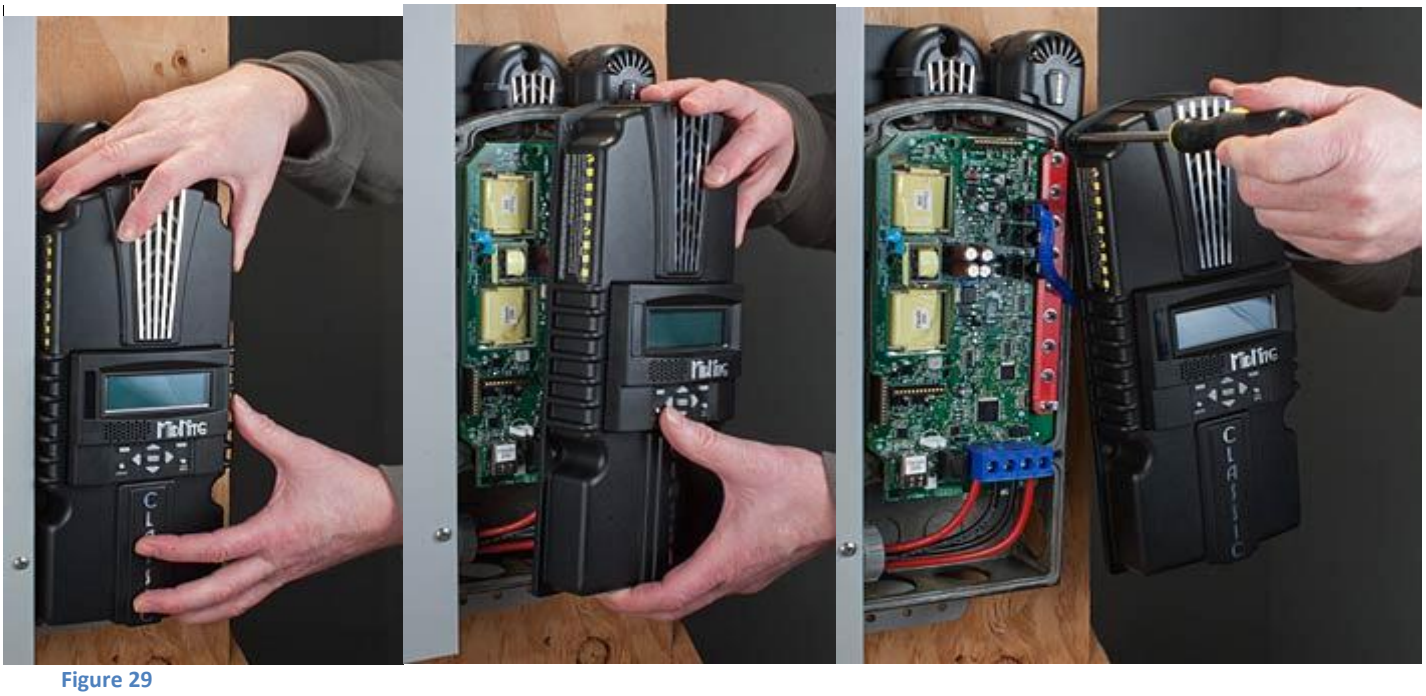


Figure 29

4. Use the provided USB cable to connect the Classic to the PC. The smaller terminal connects to the USB port on the Classic. The USB port is located on the right side of the Ethernet Jack in the lower part of the Classic.

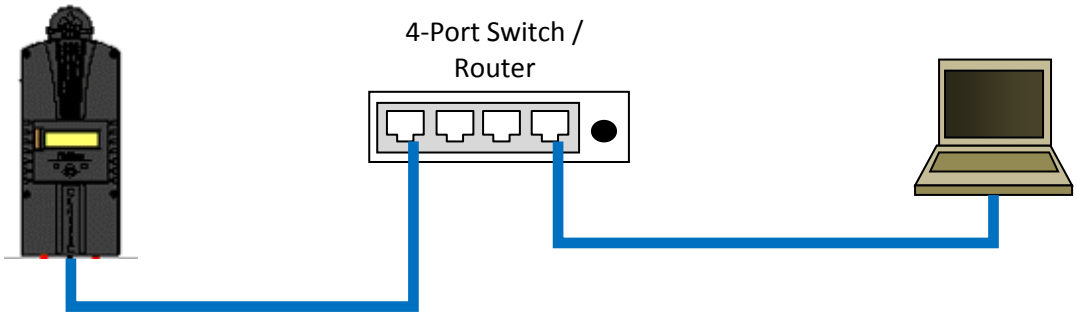
Figure 31

Figure 30

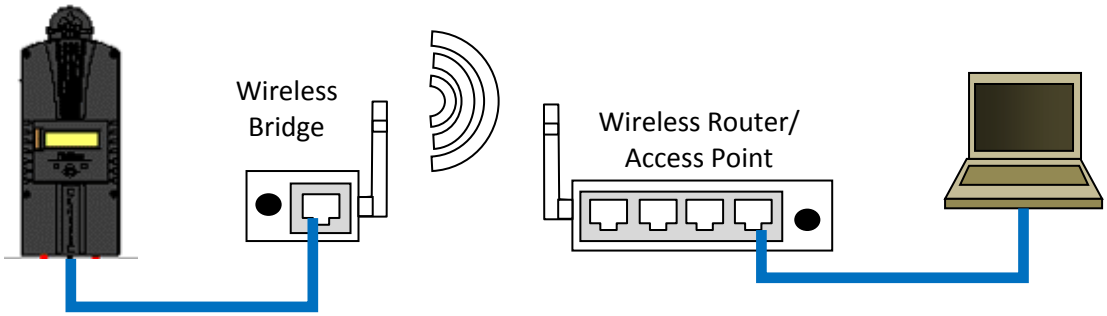
Connecting the Classic to the Internet

Networking

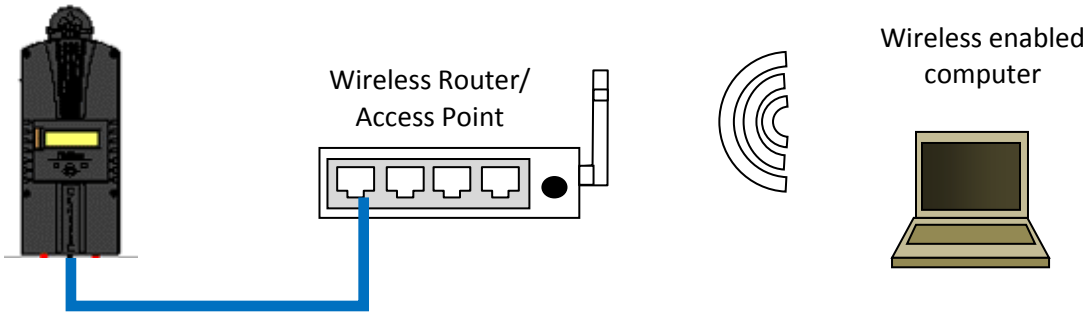
The Classic supports standard 10/100-base T Ethernet networks. For Gigabit networks you will need a common network switch that is capable of mixed mode operation. The Classic may also be placed on a, b, g, or n wireless networks by using a wireless network bridge device.
Depending on your network you may use one of the topographies detailed in Figures 5 – 5.3. Note that the switch may be self-contained or, in many cases, may already be integrated into your cable or DSL modem. Refer to Figure 1.7B for Ethernet connector location in the Classic.



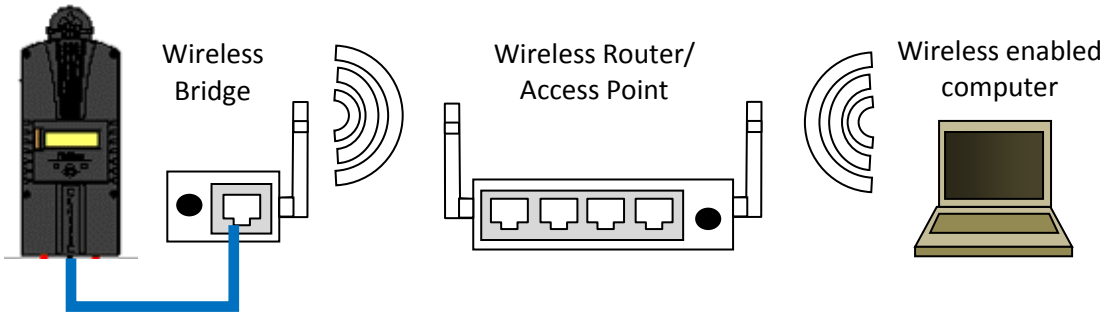
Example 1 Local network through switch. In some cases you may be able to connect Classic directly to your PC; however, this is not a recommended topography.



Example 2 Local network through wireless bridge.



Example 3 Local wireless network



Example 4 Local wireless network through wireless bridge

There are many different configurations possible when it comes to networking that are beyond the scope of this manual. The basic ones in the above figures should help get you going.

Network Setup Through the MNGP

The Classic's Ethernet capabilities may be configured using the Network menu on the MNGP. From the main menu select "NET".
There are three screens that configure network settings. Table TBD decodes the descriptions from the MNGP's small screen.

MNGP	Long-hand	Description
Mode	IP address configuration mode: DHCP/Static	The Classic supports both static and dynamically (DHCP) allocated IP addresses. If you are unsure which to choose try DHCP first. If you have trouble move to the troubleshooting section.
IP	IP Address	The Network address of the Classic
SN	Subnet	The Subnet or address class specifier
GW	Gateway Address	The address of the network's gateway device
D1	Primary DNS Address	Primary Address lookup device
D2	Secondary DNS Address	Secondary Address lookup device (optional)
Web Access	-	Enables or disables the Classic's online web service feature
MA	MAC Address	The hardware or Ethernet address of the Classic
DI	Device ID	The unique MidNite Solar address of the Classic

Table 10

DHCP

The Classic supports Dynamic Host Configuration Protocol (DHCP) in which all networking settings are derived from a DHCP-enabled router. This is the simplest configuration method and recommended unless you explicitly need a statically allocated IP address for your Classic. In this mode all other settings are automatically configured and are read only (informational) with the exception of the Web Access feature.

- Press Main Menu
- Scroll to NET menu and press the Enter button
- Highlight and select DCHP

Please note that the Classic's DHCP protocol implementation usually takes a few seconds up to a minute to update the network settings. If the network settings do not update within a minute, please consult the troubleshooting section.

Static IP

The Classic supports static IP address allocation. In this mode you can assign the Classic a specific IP address. This lets you set up things like port forwarding from your router or for networks with static IP allocations.

- Press Main Menu
- Scroll to **NET** menu and press the Enter button
- Highlight and select **STATIC**
- Using the left and right keys, navigate to the settings to change and use the up and down arrows to adjust the desired fields.
- Press the **COMMIT** softkey at any time to commit the settings to the Classic's Flash memory.

Please note that static settings span two menu screens. You may use the soft keys to navigate between the two menus. Pressing the **ENTER** key in either menu saves all settings to Flash memory.
For convenience when you manually set the device's IP address the Gateway and Primary DNS addresses follow the change. See the following sections for details on each of these fields.

IP Address

This is the local network address of your Classic. It usually takes the form "192.169.0/1.x" or "10.0.0.x" depending on your networking equipment. You must be careful when selecting this address. If it does not match your network subnet then the classic will not be able to communicate with the network. If it is the same as another device on the network then collisions will occur causing both devices to act erratically. Check your router settings or ask your network administrator which local address to use. Also refer to the troubleshooting section for tips.

Subnet

This refers to the class of local network you are using. This depends on your network hardware but most users should use "255.255.255.0" for this field.

Gateway

This is the address of your router or modem – the device which is connected directly to the Internet proper. It will usually take the form 192.168.0/1.1 or 10.0.0.1 depending on your network configuration and hardware. Check your router settings or ask your network administrator which local address to use. Also refer to the troubleshooting section for tips.

DNS 1 & 2

The DNS is the means by which human-readable internet addresses are resolved to actual IP addresses on the network. These values can usually be set identically to the gateway address depending on your network hardware. If your ISP provides you with specific DNS servers then use those addresses in these fields instead.
Example 1: Your gateway is a DSL modem with address 192.168.1.1. If your ISP has not given you explicit DNS servers to use then set the **D1** field to 192.168.1.1. **D2** can be ignored.
Example 2: Your gateway is a cable modem with address 10.0.0.1. Your ISP has specified primary and secondary DNS server addresses of 11.22.33.44 and 11.22.33.55, respectively. Set the **D1** address to

11.22.33.44 and the **D2** address to 11.22.33.55.

Web Access

MidNite Solar will be offering a free web service with which you can access your Classic from a web page from anywhere in the world simply by pointing your favorite web browser to http://www.mymidnite.com
See the web section further on for instructions on how to create an account and use the web-based system. All communications between the Classic and MidNite Solar's server are encrypted using a strong session-based algorithm. To respect your privacy, however, it is required that you manually enable this feature if you'd like to use it.
In order to enable the web access feature:

- Press **Main Menu**
- Scroll to **NET** menu and press the Enter button
- using the soft keys, navigate to the **ADVANCED** menu **(NET→NEXT→ADVANCED)**
- The **Web Access** option should be highlighted.
- Use the up/down keys to now enable or disable the feature.

Note that the **Web Access** selection indicates the current setting of the feature: i.e. **ENABLED** means the feature is currently in operation.
Note also that you will need the values **MA** and **DI** handy in order to create an account on the MidNite Solar web site. This unique number pair identifies your particular classic to our server and helps to prevent malicious users from trying to access your Classic. The **DI** or Device Id is different than your Unit's Serial Number.

Local Network

Note that your classic identifies itself by name to DHCP-enabled routers as "Classic". There is facility to change the name of a given classic via the local and web-based interfaces as well as using third-party MODBUS software packages.

Advanced
The Classic advertises its address every 10 seconds using the UDP protocol on port (TBD). Advanced users and programmers may use this feature to identify Classics on their network.

Positive Ground systems

When installing the Classic in a positive ground systems there are a few extra steps that need to be taken. The Ground fault jumper needs to be removed, and ground fault needs to be disabled in the menu. Refer to page Disabling GFP on page 22 for instructions on doing this.

The overcurrent protection needs to be done a little different as well. The input and output breakers need to be double poles. Battery negative and positive conductor both need to be protected. Refer to Classic Breaker Sizing on Page 76.

IMPORTANT: Do not connect both, positive battery and positive PV input to ground. One or the

other positive (normally battery +) but not both otherwise the Classic input and output will be shorted.

HyperVOC ™

HyperVOC is a unique feature the Classic has built in. HyperVOC refers to; when the DC Input Voltage raises above the maximum operating voltage (150V, 200V, 250V, depending on the Classic model). HyperVOC gives you the flexibility to go up to the maximum operating voltage PLUS the nominal battery voltage. For example, the Classic 150 has an input voltage rating of 150 operating volts, if the Classic 150 is connected to a 48 volt battery bank, the HyperVOC voltage limit will be: 150V + 48V a total of 198 Volts that the Classic can withstand without breaking. When the Classic input voltage rises above 150 volts it will switch off (stop outputting power). As long as the Classic is in HyperVOC mode, the microprocessor and all other functions like AUX will continue running. When the input voltage comes back down below 150v (or the rated operating voltage of the Classic, depending on model) the Classic will wake up and start charging again automatically. This could happen in a really cold morning with a system that has a Voltage Open Circuit (VOC) close to the maximum operating input voltage.
Note 1. A **HyperVOC** message will be displayed on the bottom right side of the Status screen.
Note 2. Max nominal battery voltage to be added is 48v

HyperVOC can be useful in overcoming an industry shortcoming in charging 48 volt battery's with standard panels. For example let's take a sample system with Solar World 165's that have a VOC of 44.1vdc. The industry has limited us to 2 of these panels in series making it hard to charge a 48vdc battery on hot summer days. With the Classic we designed in Hyper VOC to allow you to run 3 of these in series. 3 panels at 44.1vdc will give you a total VOC of 132.3vdc. When temperature compensated for cold climates to 125% gives you 165vdc. This is above the maximum safe limits for most controllers but falls well into the Hyper VOC range of the Classic. We do have to use Hyper VOC wisely though if we abuse it the Controller will never wake up in colder weather.

Troubleshooting

Classic will not power on. "No self test on power up"	*Check for voltage between the Battery + and the common – on the blue terminal block inside the Classic. If voltage is present and above 10vdc contact customer service. If no voltage is present back step through the + and – to find the fault.
Classic Display is blank but Classic is on.	*Check that the blue cable is plugged in between the display and the top most jack on the circuit board. *Try another cable. A standard short 4 conductor phone cable will work.
Classic says "Resting" but the sun is out?	*Resting indicates a lack of power available to the Classic. Verify there is voltage on the display under "IN" that is greater than battery voltage. *Verify the Charging mode is correct for the source as well as the Mode is "ON"
Classic switches between Resting and Bulk MPPT repeatedly but produces 0 watts.	*This can be normal during low light conditions. *Watch the IN voltage and see if it is setting stable and does not change when the Classic goes from Resting to Bulk MPPT if so call customer service *Watch the IN voltage and see if it slowly drops to battery voltage (Or Close) when the Classic goes to Bulk MPPT if so this is usually a sign of a High resistance connection (Loose Connection between the Classic and DC source)
The Display shows 0 volts in (or real close) but the battery voltage looks correct.	*If this is a new install or recently altered install check for reverse polarity on the DC input of the Classic. *If this just happened out of the blue or reverse polarity has been eliminated call customer service.
The Display is showing "Mode is Off"	*Enter into the main menu and select Mode. Turn the Mode ON and press Enter to save.

Table 11

Specifications Electrical

Model	Classic150	Classic200	Classic250	Classic250KS
Operating Volts in	150VDC	200VDC	250VDC	250VDC
Max Hyper VOC	150+battery	200+battery	250+battery	250+battery
*Battery Charge Volts	12-93 volts	12-93 volts	12-93 volts	12-150 volts
**Absolute Current Output at 25°C	96a at 12v battery 94a at 24v battery 83a at 48v battery	74a at 12v battery 70a at 24v battery 65a at 48v battery	60a at 12v battery 62a at 24v battery 55a at 48v battery	40a at 120v battery
De-rate current at 40°C+	80 amperes	66 amperes	52 amperes	33 amperes
Environment	-40c to 40c			
Dimensions of Classic	14.87"X 5.95"X 4.00" 378mm X 151mm X 102mm			
Dimensions of Box	19.00"X 8.50"X 5.70" 483mm X 216mm xX145mm			
Shipping Weight	11.5 lb 4.9 kg			

NOTE: Current output ratings were measured with 75% of the PV array's VOC (Open Circuit Voltage)
*NOTE: Calculated by adding battery voltage to the maximum input operating voltage (48V battery max)
**NOTE: Measurement Accuracies: +- 0.12v, offset calibration adjustment maybe necessary

Table 12

Specifications Mechanical

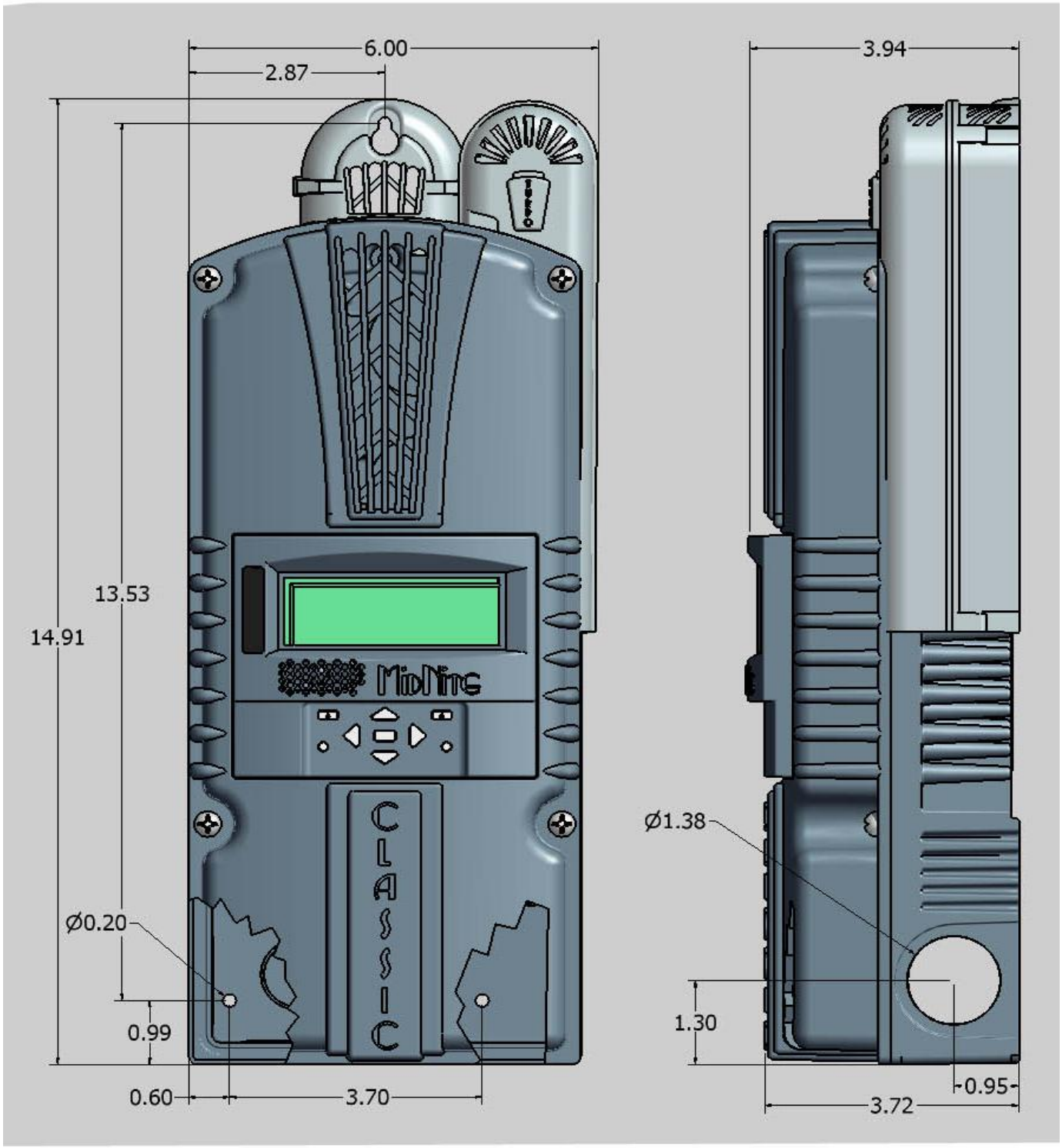


Figure 32

Default Battery charge set points

The table below describes the default preset voltages for the different nominal battery voltages. This means that if you set the Classic from the QUICK START (see page **Error! Bookmark not defined.**) to a different battery voltage the Classic will take the default voltage set points. Note. If you manually adjust the absorb float or equalize voltage set point, and then nominal battery voltage is changed to a different nominal voltage, (e.g. from 24v to 12v or to 48v etc.) manually adjustments may be required. See page 6 for further information

Battery Voltage	12v	24v	36v	48v	60v	72v
Bulk MPPT	14.3v	28.6v	42.9v	57.2v	71.5v	85.8v
Float	13.6v	27.2v	40.8v	54.4v	68.0v	81.6v
Equalize	14.3	28.6v	42.9v	57.2v	71.5v	85.8v

Table 13

To adjust these voltage set point see page 25 of this manual.

Optional accessories

Optional accessories for the Classic include:

Blank display for multiple Classic installations
MidNite network cables various Lengths.

Regulatory Approval

The MidNite Solar Classic charge controller conforms to ***UL 1741, Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, Second Edition, May 7, 1999 with revisions through January 28, 2010 and CAN/CSA C22.2 No. 107.1: 2001/09/01 Ed: 3 (R2006)***

Warranty

MidNite Solar's Classic comes with a standard 5 year warranty we will repair or replace the Classic at no charge to the consumer during this 5 year period

Appendix

Table 14

Classic Breaker sizing

Model	Bat V	MPPT V (not VOC)	In/Out ratio	Max output A	Output brkr 150VDC	Wire size 310-17*	Max input A	Input breaker/wire with 125% factor**
Classic 150	12	70	5.83	96	100	4AWG	16.46	30A /10AWG - 63A /6AWG 150V
Classic 150	24	70	2.92	94	100	4AWG	32.19	50A/8AWG - 63A/ 6AWG 150V
Classic 150	48	70	1.45	86	90-100	4AWG	59.31	80A/4AWG 150V
Classic 150	12	90	7.5	96	100	4AWG	12.8	30A /10AWG - 63A /6AWG 150V
Classic 150	24	90	3.75	94	100	4AWG	25.06	50A/8AWG - 63A/ 6AWG 150V
Classic 150	48	90	1.87	83	90-100	4AWG	44.38	63A 150V
Classic 150	12	100	8.33	92	100	4AWG	11.04	30A /10AWG - 63A /6AWG 150V
Classic 150	24	100	4.16	91	100	4AWG	21.87	30A /10AWG - 63A /6AWG 150V
Classic 150	48	100	2.08	80	80-90	4AWG	38.46	50A/8AWG - 63A/ 6AWG 150V
Classic 150	12	110	9.16	93	100	4AWG	10.15	30A /10AWG - 63A /6AWG 150V
Classic 150	24	110	4.58	84	90-100	4AWG	18.34	30A /10AWG - 63A /6AWG 150V
Classic 150	48	110	2.29	76	80-90	4AWG	33.18	50A/8AWG - 63A/ 6AWG 150V
Classic 150	12	120	10	92	100	4AWG	9.2	30A /10AWG - 63A /6AWG 150V
Classic 150	24	120	5	82	90-100	4AWG	16.4	30A /10AWG - 63A /6AWG 150V
Classic 150	48	120	2.5	76	80-90	4AWG	30.4	50A/8AWG - 63A/ 6AWG 150V
Classic 200	12	70	5.83	79	80-90	4AWG	13.55	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 200	24	70	2.91	78	80-90	4AWG	26.8	50A/6AWG or 8AWG 300V
Classic 200	48	70	1.46	76	80-90	4AWG	52.05	80A/4AWG 300V
Classic 200	12	120	10	77	80-90	4AWG	7.7	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 200	24	120	5	74	80-90	4AWG	14.8	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 200	48	120	2.5	70	70-80	4AWG	28	50a/6AWG or 8AWG 300V
Classic 200	72	120	1.66	65	70-80	4AWG	39.15	50a/6AWG or 8AWG 300V
Classic 200	12	140	11.66	74	80-90	4AWG	6.34	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 200	24	140	5.83	72	80-90	4AWG	12.34	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 200	48	140	2.92	65	70-80	4AWG	22.26	50a/6AWG or 8AWG 300V
Classic 200	72	140	1.94	63	63-70	6AWG	32.47	50A/6AWG or 8AWG 300V
Classic 200	12	160	13.33	73	80-90	4AWG	5.47	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 200	24	160	6.66	72	80-90	4AWG	10.81	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 200	48	160	3.33	65	70-80	4AWG	19.52	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 200	72	160	2.22	53	60-63	6AWG	23.87	50A/6AWG or 8AWG 300V
Classic 250	12	180	15	61	63-70	6AWG	4.06	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 250	24	180	7.5	62	63-70	6AWG	8.26	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 250	48	180	3.75	55	60-83	6-4AWG	14.66	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 250	72	180	2.5	43	50-63	6AWG	17.2	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 250	12	200	16.6	58	60-70	6AWG	3.49	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 250	24	200	8.33	60	60-70	6AWG	7.2	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 250	48	200	4.16	53	60-63	6AWG	12.74	30A/10AWG - 50A/6AWG or 8AWG 300V
Classic 250	72	200	2.77	40	40-63	8-6AWG	14.44	30A/10AWG - 50A/6AWG or 8AWG 300V

*NEC310-17 is the chart for single conductors in free air. This chart is conservatively based on this chart, 75C wire inside a MidNite E-Panel

** MidNite Solar breakers are all rated for 100% duty cycle and do not require 156% safety factor. * above also applies to input breaker and wire.

Classic Breaker sizing

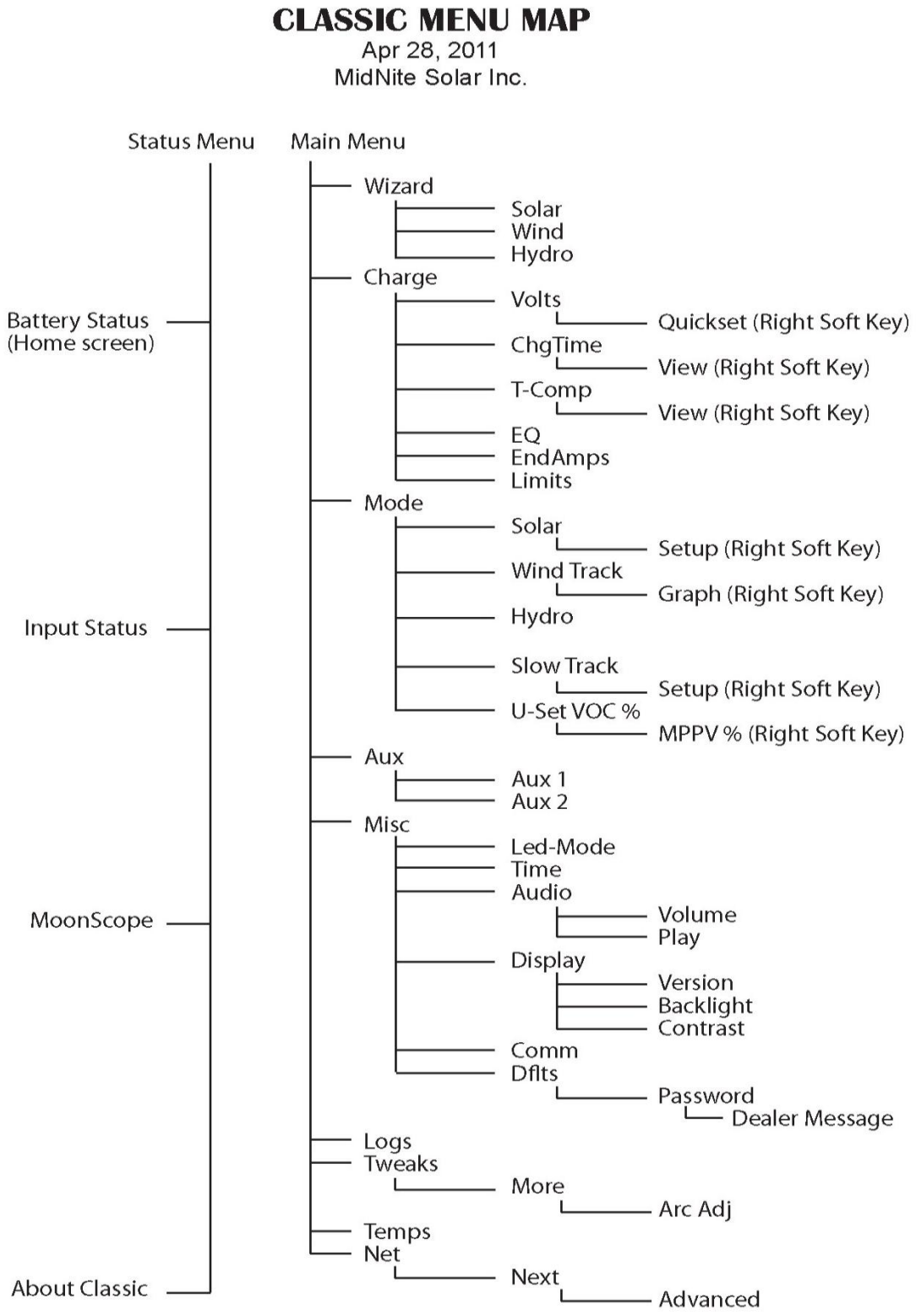
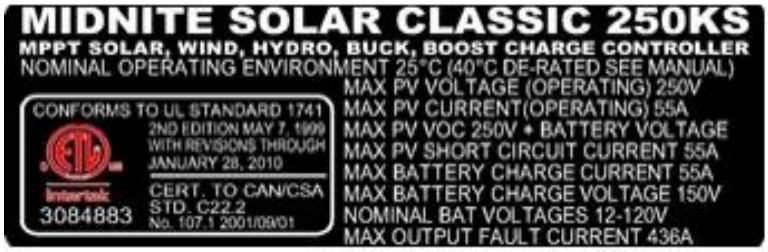

CLASSIC MENU MAP
Apr 28, 2011
MidNite Solar Inc.
Status Menu
Main Menu
Battery Status (Home screen)
Input Status
MoonScope
About Classic
Wizard
Solar
Wind
Hydro
Charge
Volts
Quickset (Right Soft Key)
ChgTime
View (Right Soft Key)
T-Comp
View (Right Soft Key)
EQ
EndAmps
Limits
Mode
Solar
Setup (Right Soft Key)
Wind Track
Graph (Right Soft Key)
Hydro
Slow Track
Setup (Right Soft Key)
U-Set VOC %
MPPV % (Right Soft Key)
Aux
Aux 1
Aux 2
Misc
Led-Mode
Time
Audio
Volume
Play
Display
Version
Backlight
Contrast
Comm
Dflts
Password
Dealer Message
Logs
Tweaks
More
Arc Adj
Temps
Net
Next
Advanced

Table 15

Label Set from Classic



RS232 Jack Pin Out

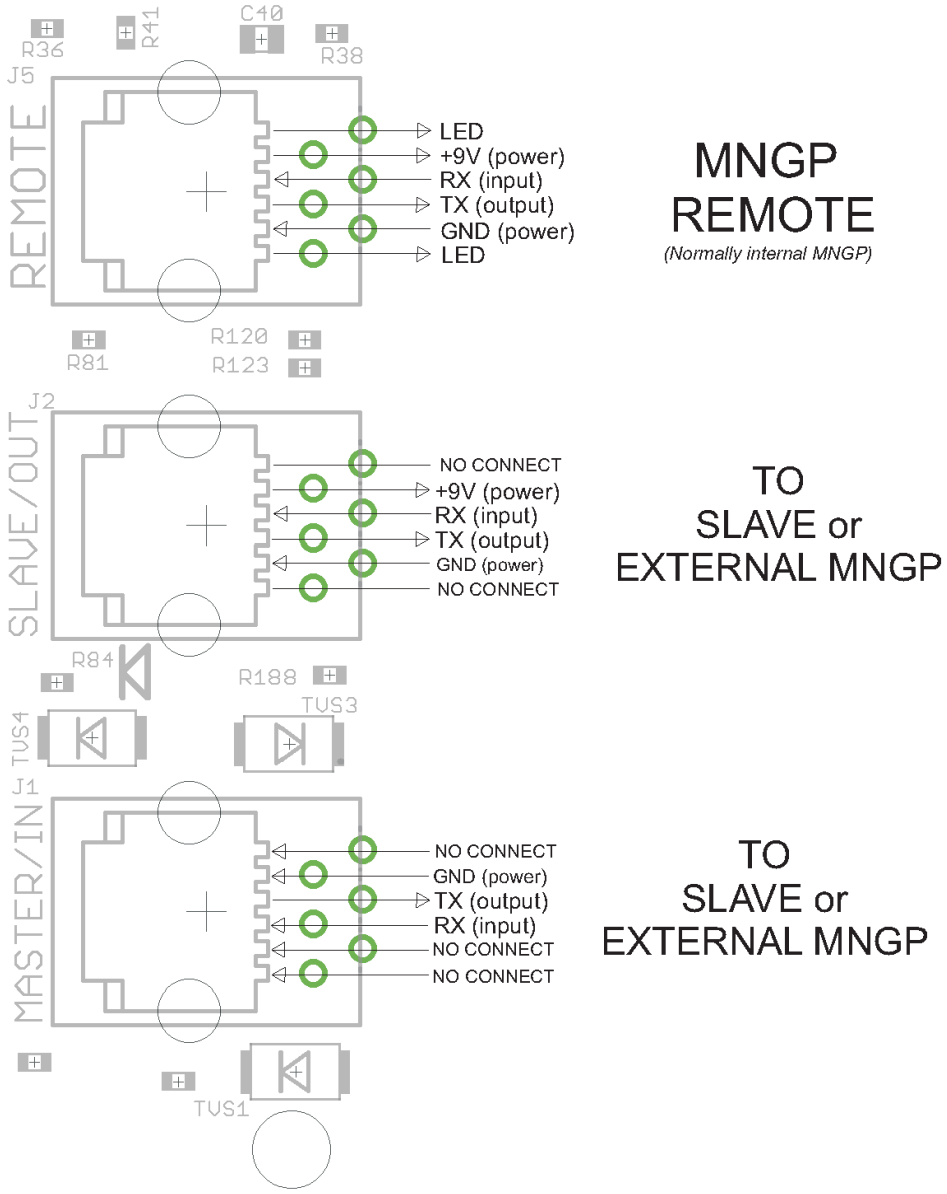


Figure 1. Classic RS-232 MODBUS RJ-11 PHONE JACK PINOUTS

Just the Facts
MidNite Solar Classic
Quick Start Guide 07/05/12

This "Quick Start" is intended to be a supplement to the Classic owner's manual. It is intended to give the basics of setting up your new Classic, when installed in a typical installation. Please refer to the Classic Owner's Manual (Included DVD or visit www.midnitesolar.com) for all advanced features, safety warnings and specifications

Este manual también está disponible en Español. La versión en Español puede encontrarse en nuestra pagina web en la ficha Documentos y haga clic en Manuales.

Ce manuel est également disponible en français. La version française peut être trouvé sur notre site web sous l'onglet Documents, puis en cliquant sur les manuels.

The MidNite Solar Classic charge controller conforms to ***UL 1741, Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, Second Edition, May 7, 1999 with revisions through January 28, 2010 and***
CAN/CSA C22.2 No. 107.1: 2001/09/01 Ed: 3 (R2006)

Contact Information
Telephone: 360.403.7207
Fax: 360.691.6862
Email: customerservice@midnitesolar.com
Web: www.midnitesolar.com

Contents

Inside view of the Classic

Take care when removing the front cover from the Classic. The graphics display panel (MNGP) may be attached to the main circuit board with a blue phone style cable as seen below if this is not the first time being opened. Unplug one end or the other and set the Front cover aside during wiring. When replacing the cover, be sure not to pinch the cable between the cover and the case and that the cable does not interfere with the components inside. You will also note the use of the top jack. For explanation of the other 2 jacks and networking diagrams please refer to the Classic User's Manual (DVD).

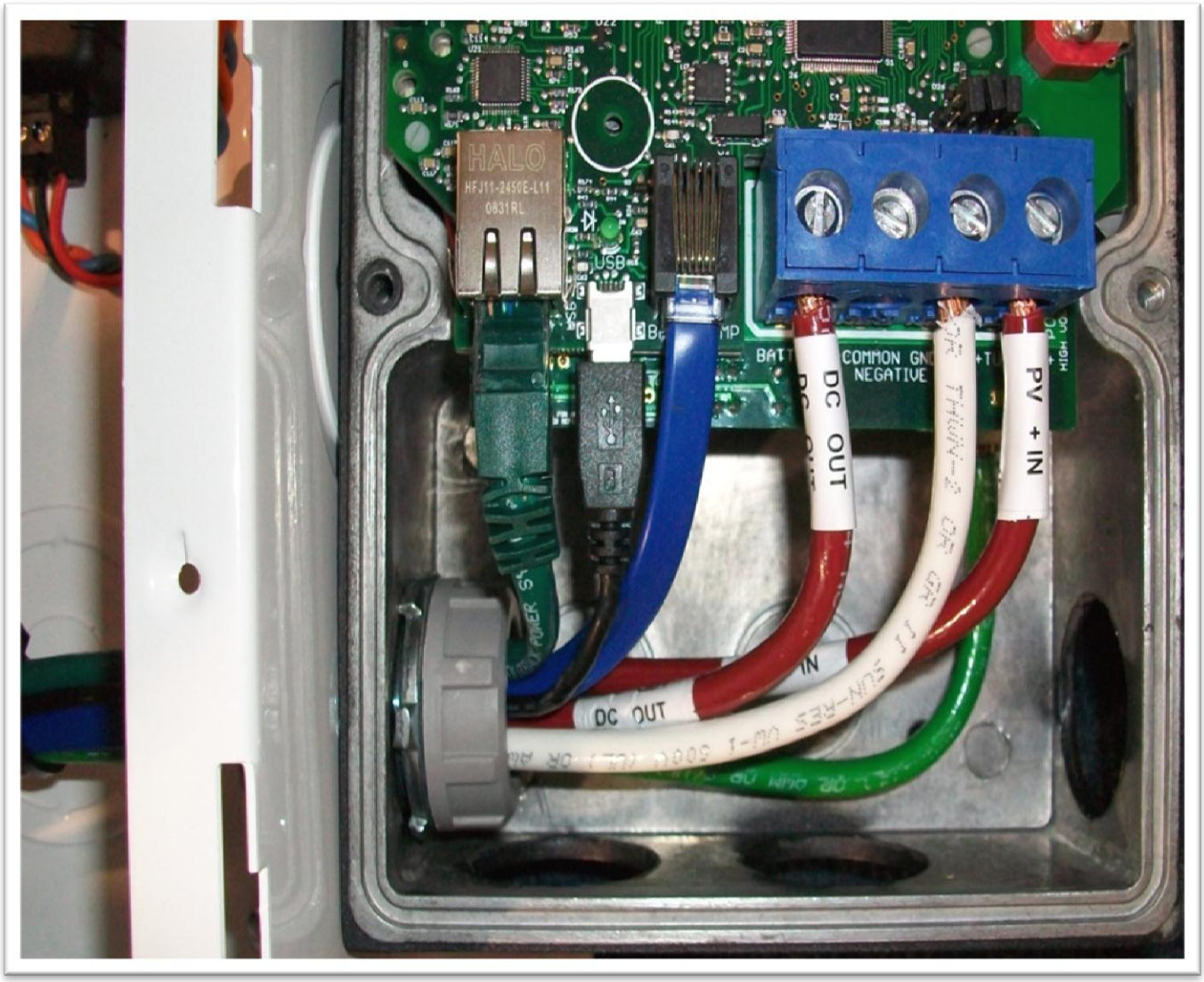


Figure 1

In Figure 1 above we show from Left to Right, the Ethernet connection to your Router or wireless bridge, USB cable for updating firmware and the Battery Temperature sensor. On the blue terminal block from left to right Battery positive, common negatives and DC input positive. You only need to bring a single Negative conductor to the Classic if you have landed PV- onto the battery negative buss in the E Panel. Both can be used if preferred.

Ground fault and Arc fault settings

There is a 2 pin header to the right of the blue terminal block for Ground Fault Protection as seen below. The supplied jumper must be installed across both pins as well as GFP enabled in the "Tweaks" menu in order for GFP to operate. To enable GFP in the Tweaks menu push the Main Menu button repeatedly until "Charge" is highlighted. Scroll to the right until "Tweaks" is highlighted, then press "Enter". Push the right soft key labeled "More" once. Now scroll to the right until the "on" or "off" under "GF" is highlighted. Use the up / down arrow buttons to change it to the desired setting and press "Enter". Please note that the above menu is the same menu where you would enable or disable Arc Fault (AF). And pressing "Arc Adjust" when in this menu will take you to the sensitivity adjustments for the Arc Fault Detection system. In this menu there will be 2 adjustments you can change to make the Arc Fault less sensitive. You can change the "Time" and the "Sensitivity". The higher the numbers the LESS sensitive the Arc Fault Detection will be. Press "Enter" to save the changes and then power the Classic down and back on to make these changes take effect.

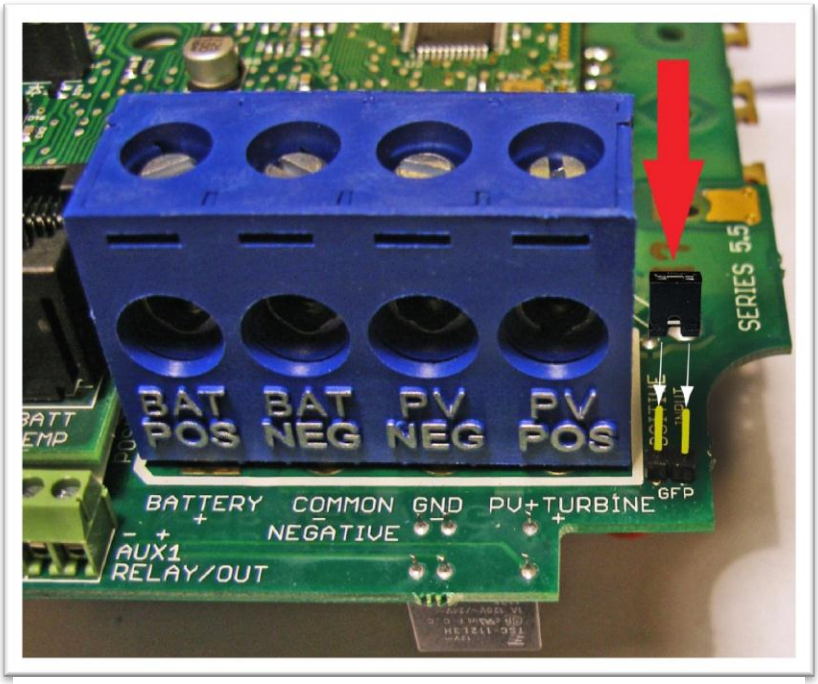


Figure 2

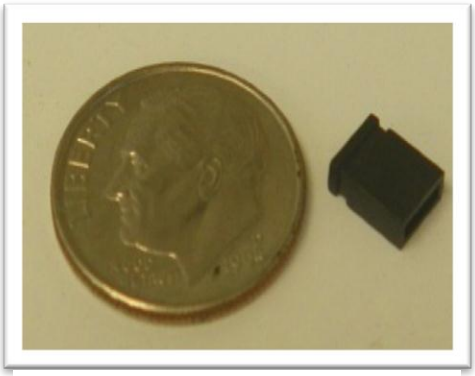


Figure 3

Non Solar inputs to the Classic

The Classic will accept a wide variety of DC inputs from sources like Solar, Wind, Hydro, Fuel Cells ETC. One of the biggest concerns when hooking the Classic to alternative sources of DC is the Voltage. Exceeding the Classics Voltage window will cause damage to the Classic.
Exceeding the Classic's Voltage window will cause damage to the Lite.
If the source is unregulated and can exceed the Classics voltage a Clipper will be needed to assure the Classic never has its voltage ratings exceeded.

For more info on alternative inputs to the Classic please consult the Classic owner's manual or contact technical support techsupport@midnitesolar.com or 360-403-7207

Wiring the Classic

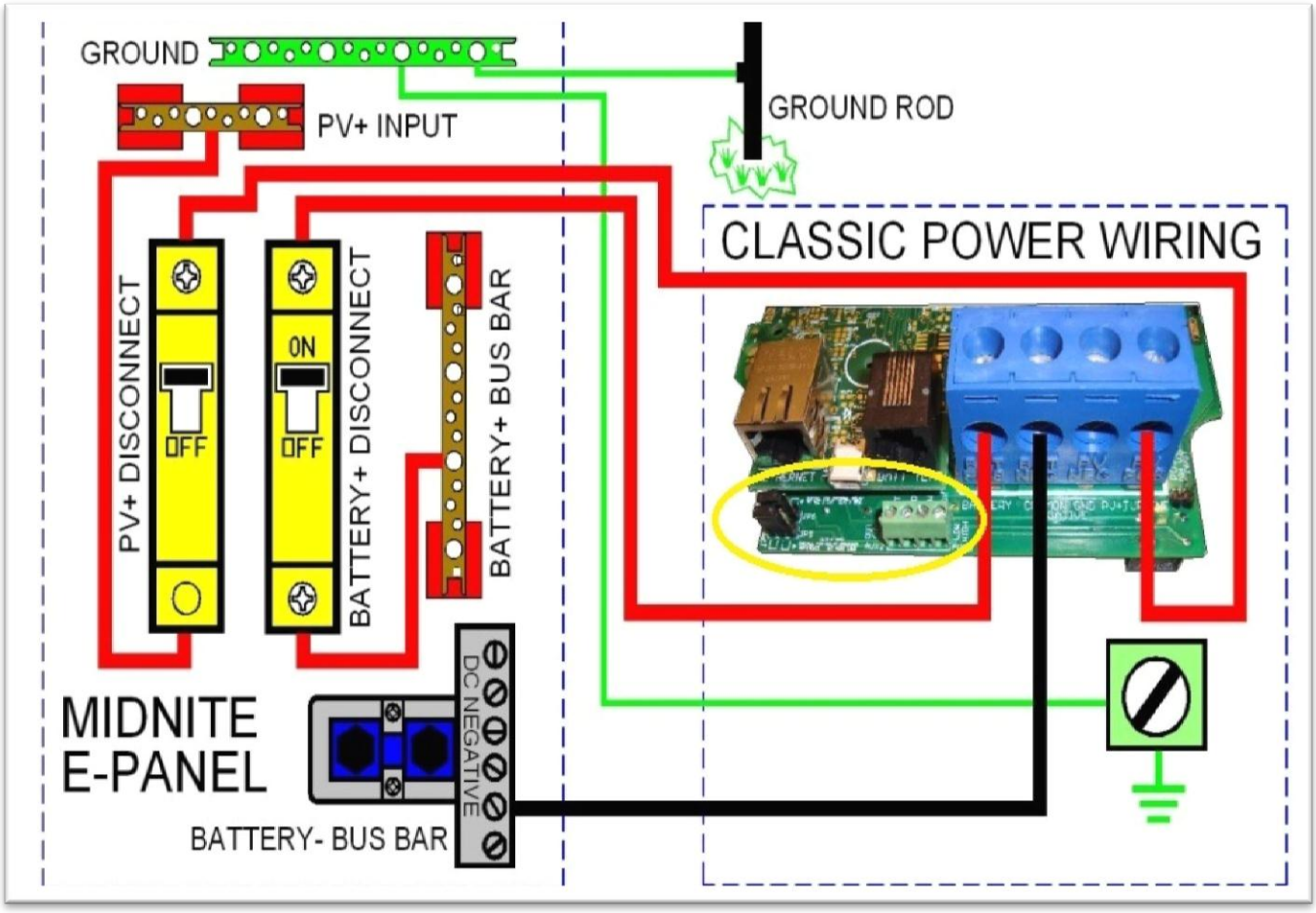


Figure 4

Above is a basic wiring diagram for installing the Classic on an E Panel. Some installations may vary. Please consult the Classic Owner's Manual for other diagrams. There are 2 jumpers and a 4 position terminal strip (Seen in the yellow oval above) for Aux 1 and 2 please refer to the Classic owner's manual for details on how to connect and use these.

Mode is Off

The Classic is unique, it has multiple charging algorithms for just about any DC input. Because we support such a wide variety of DC inputs we have also added a software "ON" and "OFF" feature. This software "Switch" basically turns the relay off effectively disconnecting the input source so the Classic will not charge the battery. If you see "Mode is Off" in the bottom right corner of the display then the Mode may have got turned off. To turn the mode back "ON" push the Main Menu button several times until "Charge" is highlighted. Scroll to the right until "Mode" is highlighted and press "Enter". On this screen "OFF" should be highlighted use the up or down arrow to change it to "ON" and press "Enter". Press the Status button once to return to the main status screen.

Note: This is the same menu you would use to change between Charging algorithms IE Solar, Hydro etc.

LED Modes and the "Blinking Red LED"

The Classic may have a Red Blinking LED on its display. This has no effect on the Classic and simply shows it is communicating with the Display. New Classics ship with this disabled. Below we will explain the different LED Modes. To change the LED Mode press the "Main Menu" button repeatedly until "Charge" is highlighted. Scroll to the right until "Misc" is highlighted and press "Enter". Now scroll to "LED-Mode" and press "Enter". Here you can use the up and down arrows to select the mode you prefer. After selecting the appropriate LED Mode press "Enter" to save this data to the Classic. Pressing "Status" will now bring you back to the home screen.

OFF – No LED activity no matter what

Rick Mode – LED Activity for Errors and Warnings only. (Over current, Arc Fault Etc)

Blinky – basically cycles all the LEDs in a Disco fashion (Useful for Partys)

LED 1 – LED activity for Warnings and Errors as well as info. A green LED on the display indicates the Classic is in Float. A yellow LED on the display indicates a warning (Over Temp, over current etc). A red LED on the Display indicates an Error (Arc Fault etc). There is also 3 LEDS inside the Classic that can be viewed through the upper vents. The red LED indicates Auxiliary 1 is active. The blue LED is not used at this time and the yellow LED indicates Auxiliary 2 is active

Restoring to Factory Default

To restore to Factory defaults you will simply need to do a "Quick Start" this will reset EVERYTHING to the way it was from the factory. To do a Quick Start, start with the power off to the Classic. While holding the right and left arrows power up the Classic and continue to hold the arrows until you see the screen below. For assistance with the 4 set up screens in the Quick Start see page 10

Figure 5

Removing the instructions and battery insulator from the MNGP

Figure 6

There is a white paper instruction sheet behind the window in the MNGP as shown in Figure 6 above. This needs to be removed. There is also a paper insulator behind the small coin battery that needs to be removed for the Clock and non-volatile memory to store its data when the Classic is powered down.

First, turn the DC input and output breaker "off" to de energize the Classic. You will need to gently pull the front cover off the MNGP. With the cover removed you can slide the paper out from behind the battery. You may want to use your finger nail to hold the battery in while doing this so it does not fall out. You will need to plug the speaker wire in as seen below. (It is not polarity sensitive) When re-installing the cover take care to get all the rubber buttons through their holes in the face of the MNGP.

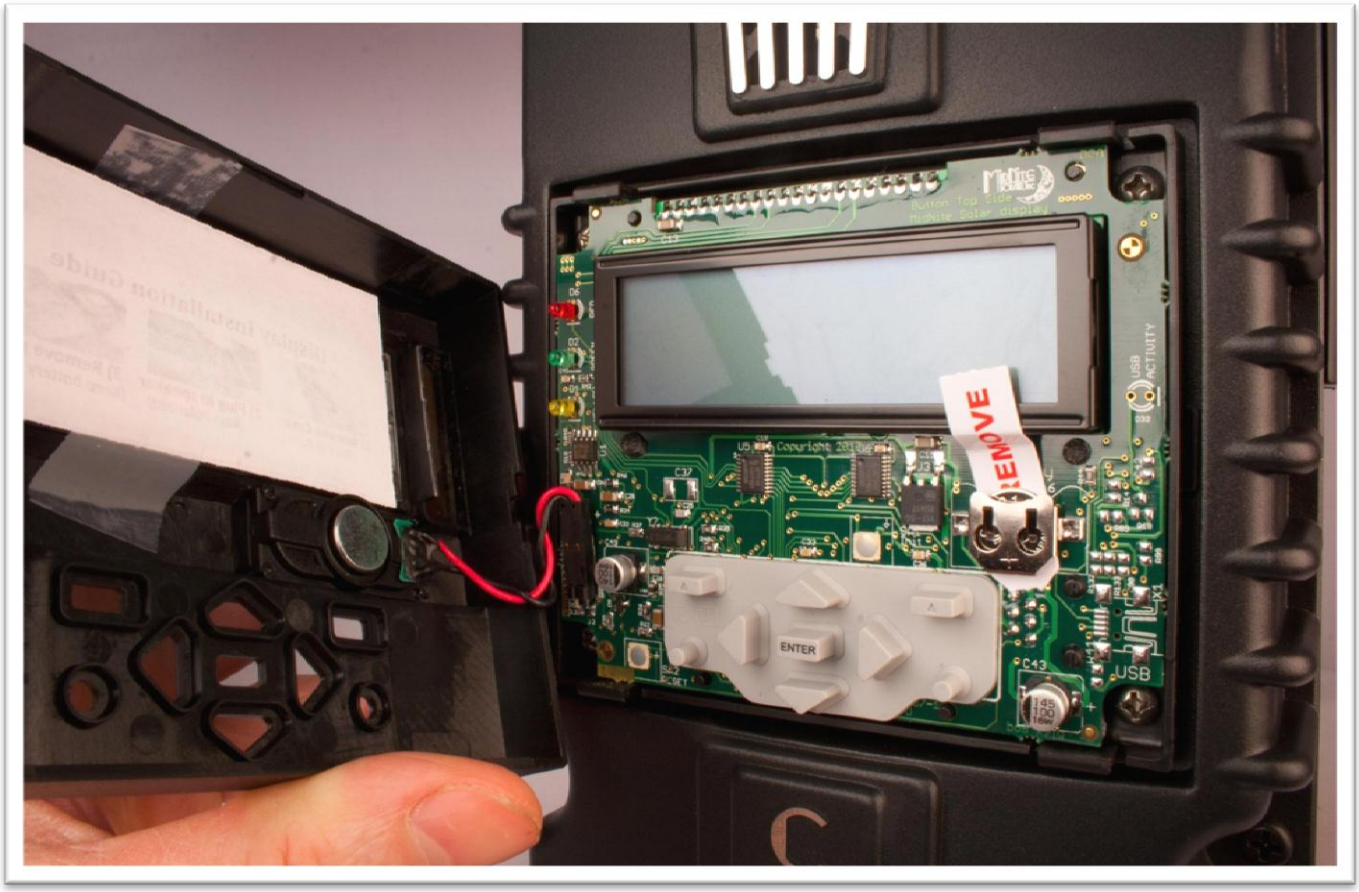


Figure 7

Initial power up / Quick Start

On initial power up the Classic should come up in the “Quick Start” with a startup screen as shown below. If this screen does not show up, or if you would like to change the battery voltage, hold the left and right arrow buttons while turning on the battery breaker to power up the Classic. Continue to hold them until the set up screen is displayed as seen below.

NOTE: This will restore all settings back to factory defaults even custom settings like Aux 1 and 2

Figure 8

Make your selection for “Solar” ”Hydro” or “Wind” using the right and left arrows to scroll and press “Enter”. Please note that almost all types of dc power sources are supported, even though they are not included in this set up. Please refer to the Classic Owner’s Manual for instructions on the proper settings for these alternative input sources.

Pushing “Enter” on the previous screen will bring you to the battery voltage quick set screen shown below. The Classic will check the system voltage and ask you to verify the correct voltage. If you would like to select a voltage other than the one shown, use the up and down arrows to select your battery voltage and press “Enter”

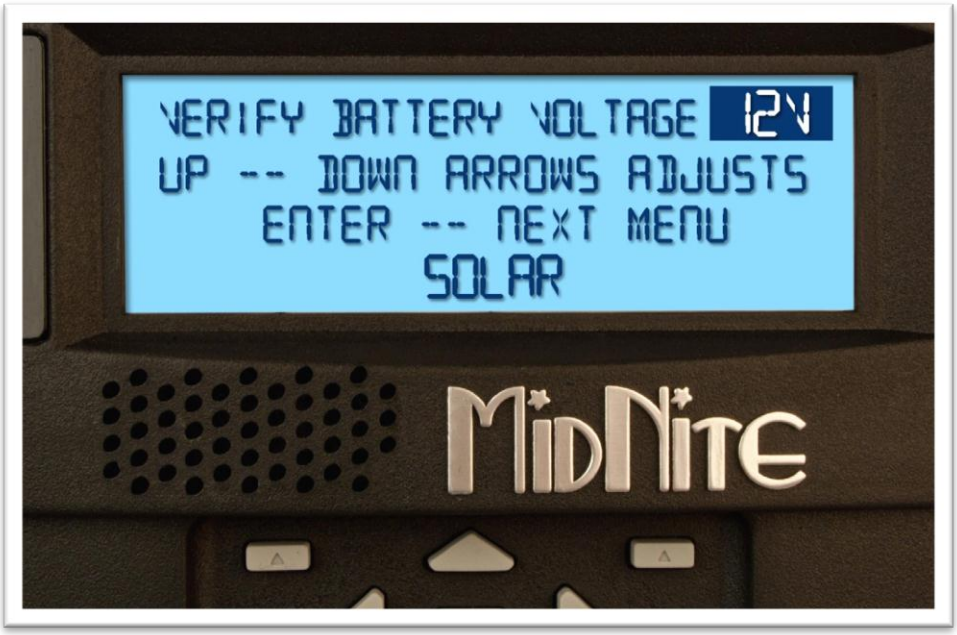


Figure 9

Pressing Enter on the screen shown above brings you to the Battery Charging Set point menu. This allows you to set the Equalize voltage, Absorb voltage and Float voltage. These values should have been supplied by the battery manufacturer. MidNite sets these to a low default so not to cause any damage to a sealed battery. You will want to adjust these to the specs of the particular battery you have. After setting all three press Enter to move to the Date and Time Screen.

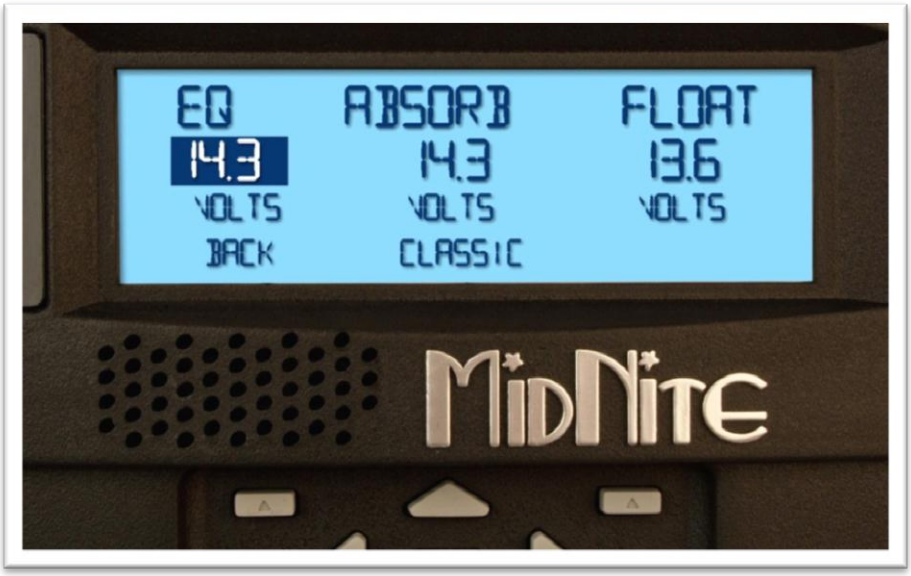


Figure 10

The Time and Date screen will appear as shown below. The time is in the 24 hour format. Set the date and time correctly and press "Enter" this will save all the settings and boot up the Classic. It will go through a couple status screens and eventually stop at the Home screen and be ready to charge the batteries.

NOTE: If using Wind or Hydro more advanced set up is required please consult the Classic Manual for the set up procedures.

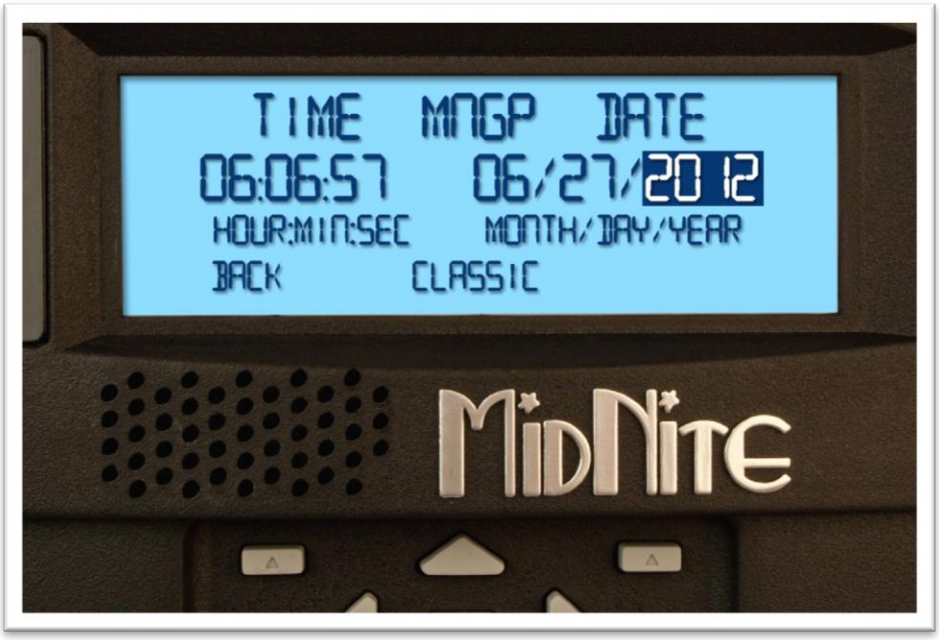


Figure 11

Classic Menus and their adjustments / Factory default settings

A brief explanation of all the Classic menus and there adjustments. To enter into the Menu's press the "Main Menu" button repeatedly until "Charge" is highlighted. This is the start of the Menu tree. Note these are in the order they actually appear in the Classic.

Charge

Volts.

EQ this is the Equalization voltage the Classic will target. This is fully adjustable from the Absorb set point up to the limit of the Classic.

Absorb this is the voltage the Classic will switch from Bulk MPPT to Absorb at. It will maintain this voltage for a specified period of time. This is fully adjustable from 0.1 volts above float to the limit of the Classic.

Float this is the voltage the Classic will float at after it completes the absorb cycle. This voltage is adjustable from 0 to 0.1 volts below the absorb set point.

Battery Voltage	12v	24v	36v	48v	60v	72v
Bulk MPPT	14.3v	28.6v	42.9v	57.2v	71.5v	85.8v
Float	13.6v	27.2v	40.8v	54.4v	68.0v	81.6v
Equalize	14.3	28.6v	42.9v	57.2v	71.5v	85.8v

ChgTime

Absorb Minimum this is the minimum time the Classic will spend in Absorb before switching to Float. Default is 30 minutes. This is adjustable from 0 to the same amount of time as the maximum absorb time

Absorb Maximum this is the maximum time the Classic will spend in Absorb before switching to Float. Default is 2 hours. This is adjustable from the time set in minimum absorb time to 18 hours.

EQ this is the time the Classic will spend at the Equalization voltage. Default is 1 hour. This is adjustable from 0 minutes to 18 hours.

Timer VW this will show the minutes the Classic is at in the Absorb, EQ or Float stage.

T-Comp

Here we set the value the Classic will use to calculate the adjustment to the charge stage voltage it is targeting. The value is milli Volts per degree C per cell. So if you have a 12 volt battery you have 6 cells. The default value is -5.0mV this can be adjusted from disabled to -10 mV in 0.5 volt increments.

EQ Comp'd this allows you to adjust the equalize voltage based on battery temperature if it "Yes" is selected. Default is No

View This will allow you to see the Temperature corrected voltage the Classic is targeting at the moment.

EQ

Here you can use the up and down arrows to select between "EQ Started" or "EQ Stopped" this will start and stop a manual EQ.

Auto EQ this allows you to set up Auto EQ. You need to select the number of days between EQ charges as well as the number of days it will try to EQ for before "giving up". If the Number of days between cycles is set to 0 it will show "Manual interval" this will require the user to actually initiate the EQ cycle. Default settings are Manual Interval. The days between EQ cycles can be set from 0 to 250 and the days to re try can be set from 0 to 1 day less than the Interval days.

View this shows the days until the next cycle. It is basically a countdown timer

EndAmps

Ending Amps This is the Output Amperage set point the Classic will switch to Float at. Default is 0.1 and the adjustment is from 0 to the output current limit setting.

Rebulk This value is a voltage the Classic watches for when it is in Float. If the Battery voltage falls to this number when the Classic is in Float it will force a new Bulk Charge. Default is 8 volts and this is adjustable from 0 to the Float voltage set point.

Limits

Output Amps This will set the maximum amount of amperage you want the Classic to allow out to the batteries. Default is the maximum allowed based on Battery voltage and Classic model. This is adjustable from 5 amps to the limit of this Classic in this setup.

Input Amps This will set the maximum amount of amperage you want the Classic to draw from its input source. Typically this is not used. Default is 99 amps and this is adjustable from 2 amps to 99 amps.

Min T-Comp This is the minimum voltage you will allow the Classic to compensate to for hot temperature on the batteries.

Max T-Comp This is the maximum voltage you will allow the Classic to compensate to for cold temperature on the batteries.

Mode

On/Off This allows you to disable the charging function of the Classic similar to turning off the Input breaker. This needs to be turned On after changing modes. Also you need to press Enter after turning it on to save this data. The up or down arrows will turn it on or off.

Mode There are several Modes, these are the input source to the Classic. The Modes are Hydro, Solar, Legacy P&O, Wind Track, Dynamic and U-Set Voc%. Most of these modes have adjustments you can make to them. Solar mode defaults to the correct settings for normal PV arrays.

Aux

AUX 1 This is where you configure the Auxiliary one relay. Default is Manual Off. Please consult the manual for Aux functions.

AUX 2 This is where you configure the Auxiliary one relay. Default is Manual Off. Please consult the manual for Aux functions.

Misc

Led-Mode This allows you to select between several modes of operation for the LED's both in the Classic and MNGP. The default is "Rick Mode" this gives errors only. For more Led functionality please see the Manual.

MNGP Here you can adjust things like Backlight (Default is 400), Contrast (Default is 690) and Volume (Default is 600). You can also hit Play and it will play a beep to allow you to adjust Audio levels to your liking.

Audio Here you can select between the Modes of speech the Classic will use. (Not active yet)

Comm Here you can set the MNGP Address (Default is 110), USB mode (Default is 00) and the ModBus Port (Default is 502) These will all be fine the way they are unless you have multiple Classic's and need to change stuff. Please see the manual for advanced functions.

Time Here you can set or correct the Time and Date. This needs to be set correctly to assure the logged data is time stamped correctly. The Classic uses a 24 hour clock not an AM/PM clock.

Pwrsv Allows you to select the length of time the backlight on the MNGP stays on after the last button activity. Default is "OFF" meaning it will always stay on. There is a short (1 minute) and long (6 minutes) setting as well.

Logs

Life Time Shows the life time Kilo Watt hours since the unit was commissioned there is also a "Time in Float" for today shown as well.

Daily Logs Allows you to scroll back through the previous 380 days of data. The prior day will be day 1 and it counts back from there. Not the days are also date stamped if the time and date where set correctly. Please consult the manual for the data that is viewable here as well as the graphs that are viewable.

Hourly Logs Allows you to view the previous 24 hours in 15 minute increments. Please consult the manual for the data that is viewable here as well as the graphs that are viewable here.

Tweaks

VBatt Allows you to calibrate the battery voltage shown on the Classics screen to agree with the actual measured battery voltage. Default is 0 volts of offset and this is adjustable from -2.5 to 2.5 volts of offset. The Number below is the voltage that will be shown on the Classic screen. NOTE if this value is off more than 1 volt please see the manual for calibrating the voltage using the potentiometer inside the Classic.

Vpv Allows you to calibrate the input voltage shown on the Classics screen to agree with the actual measured input voltage. Default is 0 volts of offset and this is adjustable from -5 to 5 volts of offset.

"More"

AF This turns Arc Fault Protection on or off. Default is Off

GF This turns Ground Fault Protection on or off. Default is ON. Note the Jumper inside the Classic will need to be installed for Ground fault protection to be enabled as well. Default on the jumper is OFF

LMX LoMax allows the Classic to drag the input voltage down to the battery voltage. Default is ON. The only down side is when in LoMax the inductors can make a little singing noise. This does not hurt anything at all but some people find the noise bothersome. LoMax is the area from battery voltage at that time to 5 volts above battery voltage at that time.

BLK This is where you would force a Bulk charge. To force the bulk charge highlight the --- and press and hold the down arrow until you see OK flash for a second.

FLT This is where you would force a Float charge. To force the float charge highlight the --- and press and hold the down arrow until you see OK flash for a second.

"More 2"

A-Rst This will make the Classic do a reboot at Midnight. Default is Off. This can be usefull for very remote sites where loss of network activity over the internet for example would be devastating.

A-EQ-R This will reload the EQ counters to start over on the cycle. To do this highlight the --- and press and hold the down arrow until OK flashes.

DvrtCnt This will allow the timers for the charge stages to run when diverting through Aux 1 or 2. Default is On

"More3"

Insomnia When ON will not allow the Classic to go to Resting. Default is OFF. This is mainly intended for Hydro where you want the Classic to be awake and ready when you open the water valves. Note: the Classic uses more power to be on and not charging than it does in Resting so this is not a desirable feature for low wattage PV arrays.

NiteLog When ON will log data while the Classic is resting not just while it is active. Default is ON.

Shade When ON allows the Classic to display "PV Shading" when the input voltage is less than 50% of VOC. Default is OFF

"Arc Adjust"

Mode Is default set to 1 and should stay on 1

Time Is the time the arc has to be seen for. Default is 4 and this is adjustable from 0 (Shortest) to 7 (Longest)

Sensitivity Is the sensitivity level setting. Default is 10 and this is adjustable from 0 (Most sensitive) to 15 (Least sensitive)

Note after changing the Arc Fault settings press enter to save and reboot the Classic to make them take effect.

Temps

Remote This is the temperature in C of the MNGP circuit board

FETS This is the temperature in C of the switching FETs internal on the Classic

Battery This is the temperature in C of the battery temperature sensor if plugged in

PCB This is the temperature in C of the Classics internal circuit board

Net

Mode Sets the Classic to static IP address or Dynamic (DHCP) Default is DHCP

IP Lets you set the IP address if Mode is Static or shows the assigned IP address if Mode is DHCP

SN Subnet Mask: Advanced configuration. Depends on network class but for most cases will be (255.255.255.0).

"Next"

GW Gateway address: Advanced configuration. The IP Address of your Internet-connected Router (Usually 192.168.x.1 / 10.x.0.1)

D1 Primary DNS Address: Advanced configuration. Primary DNS Address provided by your ISP. In some cases may be set to Gateway Address.

D2 Secondary DNS Address: Advanced configuration. Secondary DNS Address provided by your ISP.

"Advanced"

Web Access Allows you to Enable or Disable the Classics web server. Default is Disabled. The web server is what allows the Classic to talk to our server storing data for you to access remotely via My MidNite

MA The Classics Mac address. This is not adjustable and is unique to every device

DI The Classics Device ID. This is not adjustable and is unique to every device

Charging Voltage, Time and Limits adjustments.

There may be a desire to adjust the charge voltage, time set points and Limits to something other than the factory defaults.

Voltage

Follow these instructions to change the EQ, Absorb and Float voltage set points. Press the Main Menu button repeatedly until "Charge" is highlighted and press "Enter". Use the 4 arrow buttons to scroll and highlight "Volts" and press "Enter". On this screen you will notice 3 voltage set points. The left and right arrow buttons scroll between the 3 voltage set points. The up and down arrow buttons will change the voltage set points. When all 3 set points are adjusted correctly press "Enter" to save the data to the Classic. When you are finished making adjustments press the "Status" button once to return to the main status screen.

Note: The EQ set point will not go below the Absorb set point. The Absorb set point will not go below the Float set point.

Time

Follow these instructions to change the Absorb Minimum and Maximum and Equalize times. Press the Main Menu button repeatedly until “Charge” is highlighted and press “Enter”. Use the 4 arrow buttons to scroll and highlight “ChgTime” and press “Enter”. On this screen you will notice 3 time set points. The left and right arrow buttons scroll between the 3 time set points. The up and down arrow buttons will change the time set points. When all 3 set points are adjusted correctly press “Enter” to save the data to the Classic. When you are finished making adjustments press the “Status” button once to return to the main status screen.

Note: The Classic will adjust the time it spends in Absorb based on the time it spends in Bulk MPPT. You will want to set the Minimum time accordingly. For more explanation on how the Classic calculates its time spent in Absorb please refer to the Classic Owner’s Manual.

Limits

Follow these instructions to change the Maximum output and input current as well as the Minimum and Maximum temperature compensated voltages. Press the Main Menu button repeatedly until “Charge” is highlighted and press “Enter”. Use the 4 arrow buttons to scroll and highlight “Limits” and press “Enter”. On this screen you will notice 4 set points. The left and right arrow buttons scroll between the 4 set points. The up and down arrow buttons will change the set points. When all 4 set points are adjusted correctly press “Enter” to save the data to the Classic. When you are finished making adjustments press the “Status” button once to return to the main status screen.

Note: When upgrading firmware on Classics with firmware older than 11-7-11 the Input Current limit can be set to a randomly low number. Please refer to the Limits section above and adjust the “Input Current limit” to an appropriate level (Typically 99 amps).When upgrading firmware always check your custom settings to make certain nothing changed.

Setting the Date and Time

The Classic internal clock itself is synchronized from the MNGP (remote) after first powered up, at night as the daily statistics are being stored or when the ENTER key is pressed in the MNGP MISC Time/Date set menu.

You need to set the date and time on the Classic so the Data Logging will be accurate. To set the date and time on the Classic push the Main Menu button several times until “Charge” is highlighted. Scroll to the right until “Misc” is highlighted and press “Enter”. Use the Left, Right, Up and down arrow buttons to scroll until “Time” is highlighted and press “Enter”. The left and right arrow buttons will scroll through the time and date settings. The up and down arrow buttons will change these set points. When you have the date and time set push “Enter”. When you are finished making adjustments press the “Status” button once to return to the main status screen.

If, for any reason, the Classic should erroneously time stamp a logging data point less than the year 2011, the displayed time and date in either DAILY or HOURLY modes will flash between the wrong date and the word INVALID. The word INVALID does not necessarily mean that the data itself is invalid... It may just mean that the time/date was not properly synchronized in the Classic from the MNGP at the time this data was captured.

Auto Equalization (AUTO EQ)

The Classic can be set up to automatically equalize your batteries periodically, programmed as days between Equalization and the number of days the Classic will try to finish the programmed equalization charge cycle.

To set up Auto EQ go into the CHARGE menu and highlight “EQ” and press “Enter”. Now press the SOFT RIGHT key labeled "AUTO EQ". Pressing the AUTO EQ soft key enters the Auto EQ setup menu screen. The left side of the EQ setup menu will show and select the number of days, or "interval” between auto EQ charge cycles. If set to zero (0), it will display MANUAL which is the same thing as DISABLED.

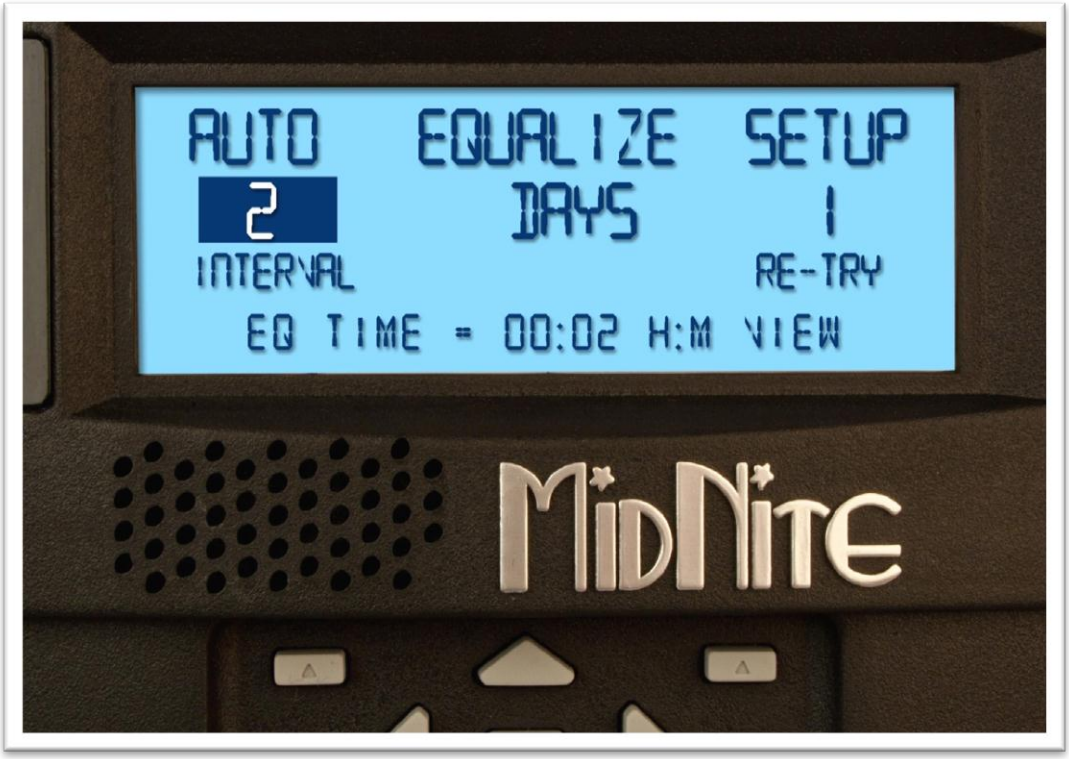


Figure 12

On the right side of the Auto EQ setup menu is the number of DAYS that the Auto EQ will retry if it does not finish the number of Hours and Minutes the Classic has been programmed to EQ for during the first day. For instance you set the Auto EQ for an interval of every 30 days and the RE-TRY for 3 days. Then the first day it attempts an EQ the Classic only accumulates 1 hour of a 2 hour EQ cycle, the next day the Classic will re attempt the EQ cycle. If the Classic still didn't finish the EQ cycle on the 2nd day of its 3 allotted re-try days, it will have one more day to try to finish the Equalize cycle. After this, if it did not complete the 2 hours of EQ time, it will not continue another day. The Classic will show “EQ DONE" on the status screen until either the start of the next day or until the user presses a button on the MNGP to stop it earlier.

At the bottom of the AUTO EQ screen shows the time, in hours and minutes, that the EQ is set for.

Pressing the Soft Right key, labeled "VIEW", takes you to a screen where you can view the interval and re-try counters (timers).

Viewing Logged Data

The Classic logs 380 days’ worth of data in its memory. The data logging in the Classic has two modes and frequency of data capture.

DAILY HISTORY
Is captured once each day and is saved at night, after 2 hours of no activity when the PV input voltage is below battery voltage for solar, or in modes that do not necessarily rest at night, like wind or hydro, the capture will happen once every 24 hours. Data logged each day is kilo-watt-hours, Float time in hours and minutes, the maximum power output for the day, maximum FET temperature inside the unit, maximum PV or input voltage and maximum battery voltage for the day.

HOURLY HISTORY
Also referred to as "Short term History" is captured once every five 5 minutes anytime the Classic is not resting (when it is charging). Data logged every 5 minutes is power, input voltage, battery voltage, Charging Stage, amps out and kW-Hours.

A time and date stamp is associated with each data entry in both Daily and Hourly history logs. The main time/date stamp for each data logging mode is Date for daily history and Time for recent history although both time and date are stored and displayed for each logging mode.

Figure 13

When entering the "LOGS" menu, you will see two items displayed there. The top line is lifetime kW-Hours for the Classic and below that is time spent in float today. (Note: Float, Absorb, Bulk and EQ time is also viewable in the "TIMER VU" sub-menu of the "ChgTime" menu in the main CHARGE menu) Pressing the SOFT LEFT key enters the DAILY history data viewing menu. Similarly, pressing the SOFT RIGHT key enters the HOURLY recent history data viewing menu.

In the DAILY menu, the LEFT side category of information displayed can be changed by pressing the UP or DOWN arrow keys. Switching over to the RIGHT side of the screen by pressing the RIGHT arrow key highlights the DAY change key. Pressing the UP key decrements the date (goes back 1 day) and displays that capture date above the word "DAY". There are 380 days of information stored in the Classic. After 380 days are captured and stored, the oldest data stored will be overwritten as new daily data fills in as the most recent data.

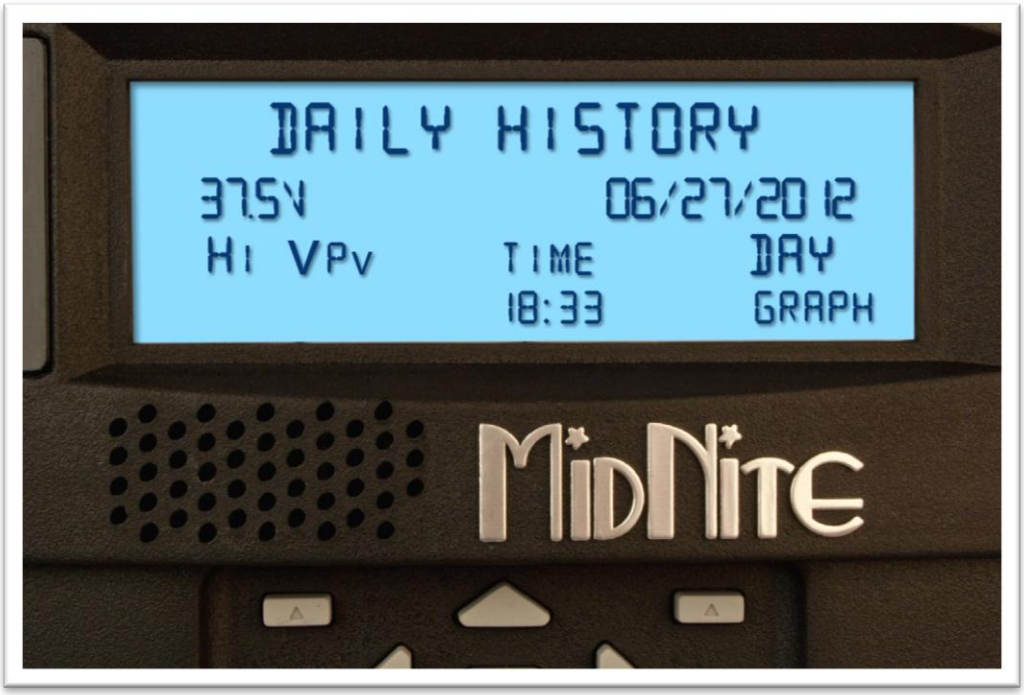


Figure 14

The HOURLY log menu (actually captured every 5 minutes), works very similar to the DAILY log menu, except that the time stamp above the word TIME is the time, shown in 24 hour format, that the data was captured that day. The category of data captured is of course more suited for minute by minute capture rather than the maximum data statistics captured on a day by day basis in the DAILY log screen. The left side of the recent history text log screen can be individually viewed by selecting the left side and pressing the UP/DOWN arrow keys to show the power, voltages, charge stage etc and various information captured at the time shown on the right side time selection.

Figure 15

At the bottom of the DAILY text log screen, the TIME the maximum statistics were stored is shown, whereas at the bottom of the HOURLY text log screen, the DATE of the capture is shown. Again, if for some reason the year of the time stamp was less than 2011, the time/date will alternate between INVALID and the time/date stamped along with that data and does not necessarily mean the data itself is not correct. If the data is all zeros and the year is shown as 2000, the data IS most likely invalid and not correct or the logging memory has not been filled yet. This is why the Classic powers up with the year 05/04/2003... It means that data was actually logged but the date was not set, whereas if it is showing 00/00/2000 it will normally mean that the data is just zero and therefore invalid data as well as invalid time and date.

The upper right corner of the text log screens displays a number from 1 to 380. This number shows the index or position of the data in the 380 data log time slots. The most recently stored data has an index of 1. Two data points ago shows an index of 2, etc. This index goes for either Daily History or Recent History text log viewing screen.

Graphical Logging Display modes

Both DAILY and HOURLY logging can also be viewed in a graphical manner. While in the text viewing log screen, pressing the Soft Right key labeled "GRAPH" will bring up this view screen. The HOURLY view is also available in the main status cycle of screens, changed by repeatedly pressing the STATUS key, just after STATUS TWO screen. This is labeled as "SHORT TERM HISTORY" in the STATUS screens.

A summary of the next Status screen will be shown while holding the status button before releasing it and entering that next status screen. This also goes for the Recent History graph screen in Status.

Each data point shown in the graphical view screen is shown as a dot. There are a maximum of 96 dots, appearing horizontally per screen with some information about each dot shown on the left side of the screen. An individual data point can be selected for investigation by moving a small, flashing once per second vertical cursor horizontally across the graphed data by using the Left and Right arrow keys. The most recent data is shown on the right most

side of the first screen. The cursor first appears around 20 dots or data points from the right side of the first screen. (About 20 data points ago in history)

To scroll the data viewed one third of a screen to the left, hold the “Shift” key, the “Soft Left button”, down and tap the “Left arrow key”. Each press of this combination of buttons will scroll the graphical view horizontally another 1/3 screen. Holding the Shift key and Right arrow key on the most recent data screen will push the cursor up against the right side and onto data point one.

Pressing the Up arrow button will change the data viewed to the next category. For instance, in the Recent history graph screen, the displayed data will change from Power to input voltage, battery voltage and kW-Hours. Pressing the Down arrow key will bring the category of data back down again. A very brief 5 or 6 character annunciator displayed in the upper left corner tells us what category of data the graph is showing us. The number just below this 5 or 6 character descriptions is the actual number in volts or watts or applicable unit of data displayed at that cursor position centered on the dot of the graph. The third line down on the left side of the recent data screen shows the time stamp of that data where the cursor is positioned on the graph. Finally, the bottom left of the graph screen alternates between two indicators. One is the charge stage at the cursor position and the other is the scaling of the vertical axis of the graph. Power for instance, can show a very wide range of values and power lends itself better to using a logarithmic vertical scale, shown as LOG. Voltage and other data shows up fine using a LINEAR vertical axis scale and is spelled out on the lower left of the graphic screen.

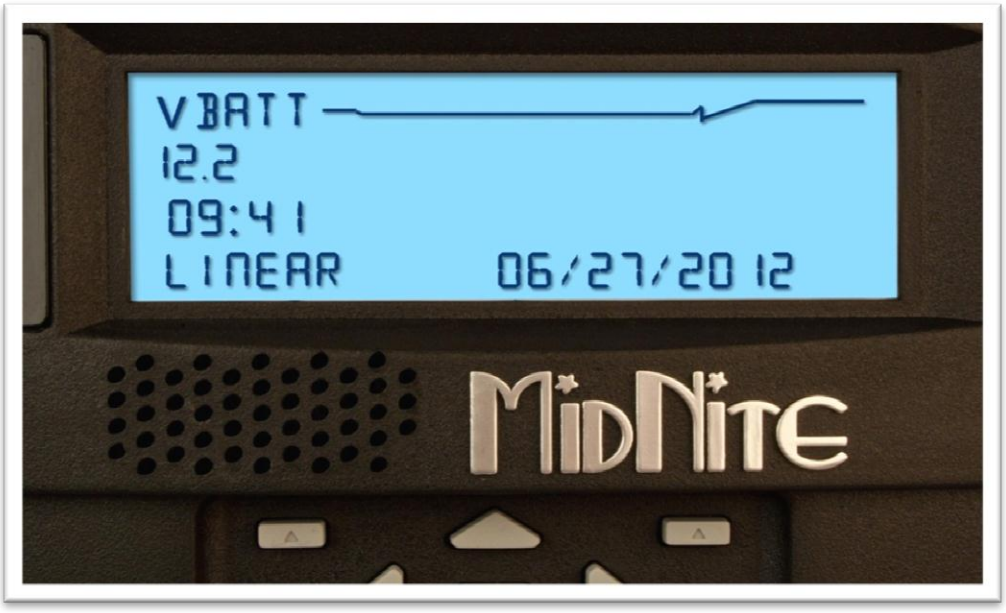


Figure 16

The Date of the particular selected cursor positioned data point is shown on the bottom middle of the graphic screen. Moving the cursor left or right using the Left and Right arrow keys, selects the next data points to the left or to the right of the present cursor position.

The flashing cursor is short and may be hard to detect at first so you may have to look for it. The cursor aligns and centers itself right on the dot itself that is selected.

The bottom date or time displayed may tend to obscure the data line graphed behind it. The time/date and the graph data will be mixed together about a second after the date/time is drawn on the bottom of that graph log screen. If, for some reason, the graphic log screen display shows bogus data or dots that look like they should not be shown, simply press the Enter button and the screen will be quickly erased and re-drawn without the extra lines or dots.

There may or may not be any valid data past a certain point to the left if the unit is fairly new. The data shown in unused spots may be zero, or it may be off the screen and not viewable. As time goes on and new data is acquired, those unused data points will start to appear and be valid. Of course, the Daily history will take many days to fill in, where the Recent hourly (minutes really) data will fill in after a few hours or maybe a day or two depending on how long the Classic is on and running for that day. Remember, the Classic does not normally log data while it is in "Resting" mode.

For additional information on the Classic please refer to the "Classic User's Manual" on the included DVD or the online version at www.midnitesolar.com

Troubleshooting

Classic display will not turn on when power is applied to the Classic but the fans do the self-test.	Display is plugged into the wrong jack. Defective cable.	Make sure the display is plugged into the 1st or 2nd jack on the main board. Any short 4 conductor phone cable can be used to test for this.
Classic will not power up and no self-test of the fans.	Insufficient battery voltage at the Classic terminals	Verify there is more than 10vdc at the Classic terminal block.
Classic says "Resting" and the sun is out.	Mode is turned Off Insufficient voltage on the input of the Classic	Refer to the manual on turning the Mode on and saving the change. Verify the Voltage on the input terminals of the Classic terminal block is greater than the battery voltage

Sunmodule®

User Instructions

07/2012

Sunmodule Plus SW xxx poly
Sunmodule Plus SW xxx mono (black)

SOLARWORLD

We turn sunlight into power.

www.solarworld-usa.com

DANGER!

Electric shock

The connection of two or more modules in series results in the accumulation of voltage and imposes danger. Do not insert electrically conductive parts into connectors! Do not attach solar modules and wiring with wet connectors! Make sure to work with dry tools and under dry working conditions!

Work on live parts

When working on wiring, use and wear protective equipment (insulated tools, insulated gloves, etc.)!

WARNING!

Arcing

Modules generate direct current (DC) when exposed to light. When breaking a closed circuit, a dangerous arc may be generated. Do not cut any live wires.

Safe installation

Do not carry out installation work in strong winds. Secure yourself and other persons against falling. Secure work materials against dropping. Ensure a safe working environment so as to prevent accidents.

Fire protection/explosion protection

Modules must not be installed in the vicinity of highly flammable gases, vapors or dusts (e.g. filling stations, gas tanks, paint spraying equipment). The safety instructions for other system components must also be followed. Make sure to comply with local standards, building regulations and accident prevention regulations during installation. For roof installation, modules must be mounted on a fire-resistant base material.

ATTENTION

Do not use damaged modules. Do not dismantle modules Do not remove any parts or nameplates fitted by the manufacturer. Do not apply paint or adhesives to the module, nor work on it with sharp objects.

Unpacking and intermediate storage

Do not use the junction box as a handle. Do not place modules roughly on hard floor or on their corners. Do not place modules on top of each other. Do not step or stand on modules. Do not place any objects on modules. Do not work on modules with sharp objects; store modules in a dry place.

Grounding of module and frame

We recommend ensuring the functional grounding of the module metal frame. If an exterior lightning protection system is already provided, the PV system has to be integrated into the protection concept against direct lightning stroke. Local standards shall be observed.

Grounding in the US and Canada

The modules can be connected to the grounding holes using a lay-in lug. The lug can be fixed:

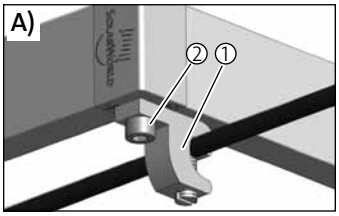
A) at the module corner by using a socket head cap screw, or

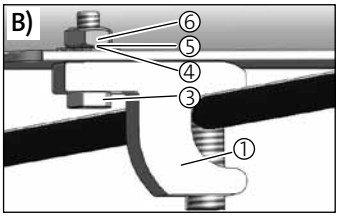
B) at the hole provided in the flange by using a screw with a serrated washer, a washer and a nut.

Any grounding method and components listed according to NEC requirements are also acceptable in the US and Canada.

Table: Recommended components for grounding in the US and Canada

Item	Manufacturer/Description	Tightening torque
Lay-In lug ①	Ilsco GBL-4DB (E34440)	35 lbf-in, 4-6 AWG str 25 lbf-in, 8 AWG str 20 lbf-in, 10-14 AWG sol/str
Socket head cap screw ②	10-24, 5/8", SS 18-8	62 lbf-in (7.0 Nm)
Bolt ③	#6-32, SS	25 in-lbs (2.9 Nm)
Serrated washer ④	M5, SS	
Washer ⑤	ID 9/64", OD 3/8", SS	
Nut ⑥	#6-32, SS	





Underwriters Laboratories Information (U.S. and Canada)

For the electrical ratings please refer to the datasheet. The fire rating of this module is valid only when mounted in the manner specified in the mechanical mounting instructions. The module is considered to be in compliance with UL 1703 only when the module is mounted in the manner specified by the mounting instructions below. A module with exposed conductive parts is considered to be in compliance with UL 1703 only when it is electrically grounded in accordance with the instructions presented below and the requirements of the National Electrical Code. Where common grounding hardware (nuts, bolts, star washers, spilt-ring lock washers, flat washers and the like) is used to attach a listed grounding/bonding device, the attachment must be made in conformance with the grounding device manufacturer's instructions. Common hardware items such as nuts, bolts, star washers, lock washers and the like have not been evaluated for electrical conductivity or for use as grounding devices and should be used only for maintaining mechanical connections and holding electrical grounding devices in the proper position for electrical conductivity. Such devices, where supplied with the module and evaluated through the requirements in UL 1703, may be used for grounding connections in accordance with the instructions provided with the module. The electrical characteristics are within ±10 percent of the indicated values of ISC, VOC, and Pmax under standard test conditions (irradiance of 100 mW/cm², AM 1.5 spectrum, and a cell temperature of 25°C (77°F)). Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. The requirements of the National Electrical Code (NEC) in Article 690-8 shall be followed to address these increased outputs. In installations not under the requirements of the NEC, the values of ISC and VOC marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, overcurrent device ratings, and size of controls connected to the PV output. To reduce the operating temperature the module has to be mounted on any surface with a minimum distance of 4 inches (10 cm).

In Canada the installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

Suitable ambient conditions

The module is intended for use in moderate climatic conditions. Artificially concentrated sunlight shall not be directed on the module or panel. The module must neither be immersed in water nor be exposed to continuous wetting (e.g. by fountains). Exposure to salt or sulfur (sulfur sources, volcanoes) implies a risk of corrosion. The module must not be used for maritime (e.g. boats) or automotive (vehicles) purposes. The module must not be exposed to extraordinary chemical loads (e.g. emissions from manufacturing plants). If the modules are installed on stables, a distance of 1 m to ventilation openings shall be ensured; apart from this, the modules shall not be used as a direct roof panel on stables.

Appropriate installation situation

Make sure that the module meets the technical requirements of the overall system. Other system components should not exert any adverse mechanical or electrical influences on the module. Modules may bend under high loads. For this reason, sharp-edged fixing elements or other sharp objects (e.g. cable ties on mounting sections must not be mounted near the module back side. For modules connected in series, only modules of the same amperage rating may be used together. For modules connected in parallel, modules with the same voltage ranges must be used together. The modules must not be operated at a higher voltage than the permissible system voltage. The inside opening of the frame corner element is intended for water drainage and must not be blocked. For system documentation, please note the serial numbers.

Optimum installation

In order to avoid performance losses, all modules connected in series should be arranged with the same orientation and tilt angle. The modules should be installed in an all-season shadow-free area. Even partial shadowing results in yield losses and is to be avoided. Ventilation of the module back side will prevent heat build-up adversely affecting performance.

Mounting

The modules must be securely fixed at a minimum of 4 locations on the substructure. Fixing is only allowed in designated areas or at the provided mounting holes. These designated areas for fixing are located on the module long sides. They are located between 1/8 of the module length and 1/4 of the module length, measured from the module corner. Fixing the module on its narrow sides is not sufficient. In regards to "Top-Down" mounting methods, the clamping area on the module frame must be at least 130 mm² (0.20 in²) for each fixing point. The required clamping pressure is 100 N/mm² (14,5 lbf/in²). For "Bottom – Up" mounting methods, use a stainless steel serrated lock nut and M8 (5/16") bolt to secure the module to the mounting structure with the provided mounting holes. The bolts must be tightened to 20 Nm (15 ft-lbs). Do not drill any holes into the module. Use corrosion-proof fixing material.

Electrical connection

The modules are provided with factory-assembled cables and connectors . Do not open the junction box in any case. Connectors may only be connected under dry conditions. Make sure to avoid gaps in a plugged connection. Only singlecore solar cables with an adequate cross-section (4 mm² minimum) and appropriate connectors may be used for connecting the modules. Cables should be attached to the installation system by means of UV-resistant cable ties. Exposed cables should be protected against sunlight and damage by suitable precautions (e.g. conduits) In order to limit voltages released by indirect lightning shock, the area of all conductor loops must be reduced to a minimum. Check that wiring is correct (polarity!) prior to starting the generator.

Cleaning

In general, the modules do not need any cleaning if the tilt angle is sufficient (> 15°; self-cleaning by rain). In case of heavy soiling, it is recommended to clean the modules with plenty of water (low pressure hose) and without the use of cleaning agents. If necessary, a soft cleaning device (sponge) may be used. Never scrape or rub off dirt as this may result in micro-scratches.

Maintenance

We recommend regular inspections of the system to ensure that:

1. All fixtures are securely tightened and corrosion-free;
2. Wiring is securely connected, properly arranged and free of corrosion;
3. Cables are free of damage;

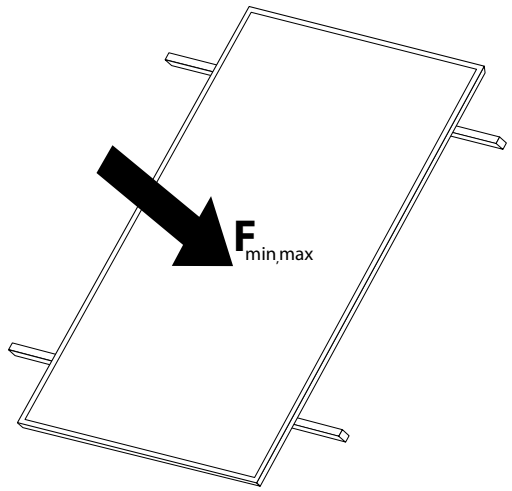
Please also observe applicable standards.

Disclaimer of liability

SolarWorld AG does not guarantee the operational capability and functionality of modules if the instructions contained in the present user information are not complied with. Since compliance with these instructions and the conditions and methods of installation, operation, use and maintenance of the modules are not checked or monitored by SolarWorld AG, SolarWorld AG accepts no liability for damage arising through improper use or incorrect installation, operation, use or maintenance. Furthermore, liability for infringements of patent law or of other third party rights arising from the use of the modules is excluded unless we are automatically liable by law.

Bottom – Up mounting method

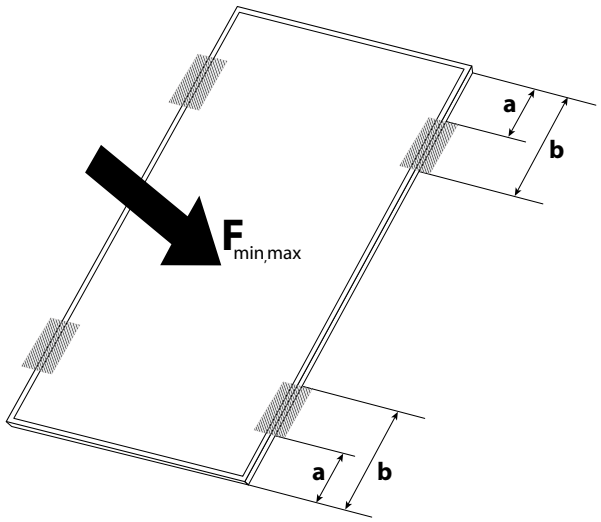
Fig. C



	UL design pressure	IEC design pressure
at provided mounting holes	F_{min} = - 30 psf (- 1,4 kN/m²) F_{max} = + 113 psf (+ 5,4 kN/m²)	F_{min} = -50 psf (-2,4 kN/m²) F_{max} = +113 psf (+5,4 kN/m²)

Top-Down mounting method

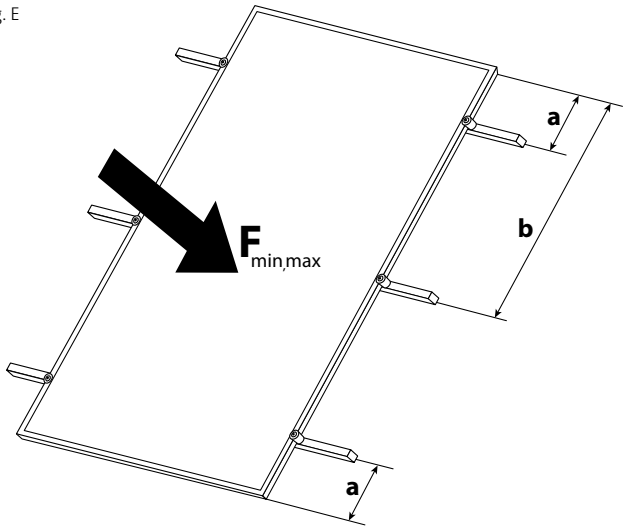
Fig. D



	UL design pressure	IEC design pressure
a = 8.2 in (209 mm) **b** = 16.5 in (419 mm)	F_{min} = - 64 psf (- 3,1 kN/m²) F_{max} = + 113 psf (+ 5,4 kN/m²)	F_{min} = -50 psf (-2,4 kN/m²) F_{max} = +113 psf (+5,4 kN/m²)

Top-Down mounting method

Fig. E

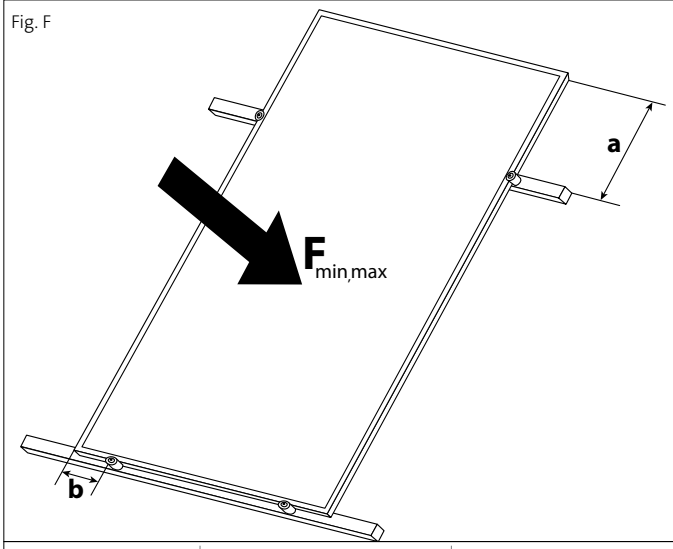


	UL design pressure	IEC design pressure
a = 9.0 in (229 mm)* **b** = 33.0 in (838 mm)*	F_{min} = - 64 psf (- 3,1 kN/m²) F_{max} = + 170 psf (+ 8,1 kN/m²)	F_{min} = -50 psf (-2,4 kN/m²) F_{max} = +113 psf (+5,4 kN/m²)

*tolerance: +/- 0.4 in (+/- 10mm)

Top-Down mounting method

Fig. F



	UL design pressure	IEC design pressure
a = 20.1 in (510 mm)* **b** = 8.8 in (223 mm)*	F_{min} = - 50 psf (- 2,4 kN/m²) F_{max} = + 113 psf (+ 5,4 kN/m²)	F_{min} = -50 psf (-2,4 kN/m²) F_{max} = +113 psf (+5,4 kN/m²)

*tolerance: +/- 0.4 in (+/- 10mm)

Revisions

Version	Changes	Date
1.0	New document	2012-07-12

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